(12)

Report No. CG-D-2-86

EVALUATION OF SURFACE CRAFT AND ICE TARGET DETECTION PERFORMANCE BY THE AN/APS-135 SIDE-LOOKING AIRBORNE RADAR (SLAR)

R. Q. ROBE

U.S. Coast Guard Research and Development Center
Avery Point, Groton, Connecticut 06340

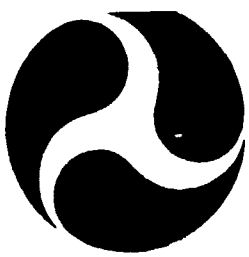
N. C. EDWARDS, Jr., D. L. MURPHY, AND N. THAYER

International Ice Patrol
Avery Point, Groton, Connecticut 06340

AND

G. L. HOVER AND M. E. KOP

Analysis & Technology, Inc.
153 Williams Street, New London, Connecticut 06320



FINAL REPORT

DECEMBER 1985

Prepared for:

U.S. Department of Transportation
United States Coast Guard
Office of Research and Development
Washington, DC 20593

NOTICE

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein soley because they are considered essential to the object of this report.

The contents of this report reflect the views of the Coast Guard Research and Development Center, which is responsible for the facts and accuracy of data presented. This report does not constitute a standard , specification, or regulation.

SAMUEL F. POWEL, III
Technical Director
U.S. Coast Guard Research and Development Center
Avery Point, Groton, Connecticut 06340

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
CG-D-2-86	AD-A164 723	

4. Title and Subtitle
Evaluation of Surface Craft and Ice Target Detection Performance by the AN/APS-135 Side-Looking Airborne Radar (SLAR)

5. Report Date
December 1985

6. Performing Organization Code

7. Author(s)
R. Q. Robe, N. C. Edwards, Jr., D. L. Murphy, N. Thayer, G. L. Hover, and M. E. Kop

8. Performing Organization Report No.
CGR&DC 15/85

9. Performing Organization Name and Address

U.S.C.G. R&D Center
Avery Point
Groton, CT 06340

Analysis & Technology, Inc.
P.O. Box 220
North Stonington, CT 06359

10. Work Unit No. (TRAIS)

11. Contract or Grant No.
DTCG39-83-C-80863

12. Sponsoring Agency Name and Address
Department of Transportation
U.S. Coast Guard
Office of Research and Development
Washington, D.C. 20590

13. Type of Report and Period Covered
Final Report
April - November 1985

14. Sponsoring Agency Code

15. Supplementary Notes
This report is the twentieth in a series which documents the Improvement in Probability of Detection in Search and Rescue (POD/SAR) project at the USCG R&D Center.

16. Abstract

During the Spring of 1985, the U.S. Coast Guard R&D Center conducted an open-ocean evaluation of the AN/APS-135 SLAR in cooperation with the International Ice Patrol (IIP). Data were collected to determine the system's ability to detect various surface craft (ranging from a 4-person life raft to a 55-meter ship) and ice targets. The effects on detection performance of target size, range, search altitude, and sea state were evaluated using the experiment data. Search altitudes of 2500 and 4000 feet and target ranges up to 25 kilometers were tested for surface craft. For ice targets, 2500-, 4000-, and 8000-foot altitudes and ranges up to 50 kilometers were used.

Analysis of the data indicated that SLAR is capable of detecting icebergs and the 55-meter ship in seas up to 2 meters nearly 100 percent of the time. The smaller targets were detected 40 to 96 percent of the time in seas less than 1 meter and 0 to 65 percent of the time in seas of 1 to 2 meters, depending on target size. Unalerted operators detected 10 to 60 percent fewer targets than alerted operators depending on target size and sea state. Detection range limits of the AN/APS-135 SLAR for targets larger than the 4-person raft were not identified using the 25-kilometer range scale.

17. Key Words	18. Distribution Statement
Search and Rescue, Side-Looking Airborne Radar, Surface Target Detection, Iceberg Detection, Electronic Search	Document is available to the U.S. public through the National Technical Information Service, Springfield, VA 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified		

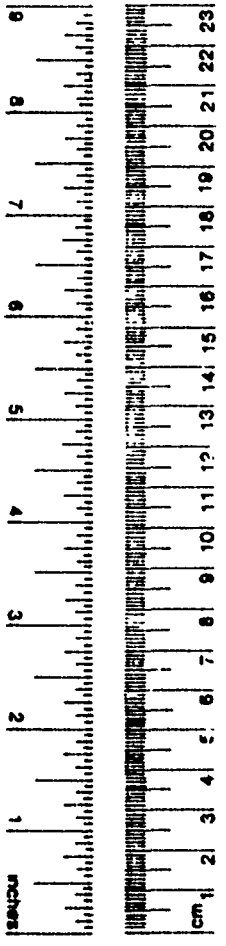
Form DOT F 1700.7 (8-72) Reproduction of form and completed page is authorized

METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

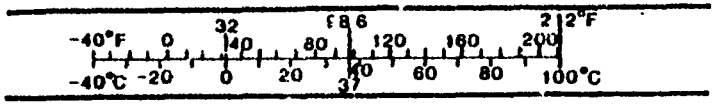
Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	* 2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (WEIGHT)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (EXACT)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures. Price $2.25. SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (WEIGHT)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	0.125	cups	c
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (EXACT)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



CONTENTS

CONTENTS (Continued)

ILLUSTRATIONS

TABLES

EXECUTIVE SUMMARY

INTRODUCTION

1. Background

This report evaluates the performance of the AN/APS-135 side-looking airborne radar (SLAR) in detecting various search and rescue (SAR) and ice targets.

During the period 27 April through 5 May 1985, an experiment was conducted in the Grand Banks area off the coast of Newfoundland, Canada, by the United States Coast Guard Research and Development Center (R&D Center), in cooperation with the International Ice Patrol (IIP). A Coast Guard HC-130 aircraft equipped with the APS-135 SLAR conducted searches for 5 SAR targets (ranging in size from a 4-person life raft to a 55-meter ship) and a variety of ice targets (ranging from under 10 to approximately 75 meters long). Coast Guard Cutter EVERGREEN provided surface truth data on all target positions and environmental conditions. During the experiment, significant wave height (H_S) varied from 0.6 to 1.8 meters.

2. AN/APS-135 System Description

The AN/APS-135 SLAR is manufactured by Motorola, Inc. It is an updated version of an earlier generation of Motorola SLARs -- the AN/APS-94 series. Pertinent system data are summarized in Table 1. The SLAR imagery is displayed and recorded on 23-centimeter, dry process negative film.

TABLE 1

AN/APS-135 SYSTEM PARAMETERS

Peak Transmitter Power:	200 Kw
Frequency:	9250 MHz (center of 9210 to 9290 MHz tuning range)
Pulse Width:	0.2 microsecond
Pulse Repetition Frequency (PRF):	375 or 750 pulses per second*
Antenna Characteristics:	
Azimuthal half-power beamwidth:	0.47 degree, one-way
Elevation shaped pattern coverage:	-1.5 to -45 degrees
Peak gain:	38.3 dB (including random loss)
Depression angle of beam peak:	1.5 degrees
Polarization:	Vertical
Receiver Noise Figure: (referred to GaAs FET preamplifier input)	5.22 dB
Receiver Bandwidth:	6 MHz
Transmitting Microwave Losses: (from magnetron to antenna)	3.96 dB
Receiving Microwave Losses: (from antenna to GaAs FET preamplifier input)	4.26 dB

*Effective PRF for each CRT. The actual transmitter PRF is either 750 or 1,500 pulses per second.

3. Approach

SLAR film was analyzed post-experiment by both alerted and unalerted operators. The alerted operators were R&D Center or IIP staff who had full knowledge of target types and locations. The unalerted operators were qualified SLAR operators from Coast Guard Air Station Elizabeth City, North Carolina. They were given the target location marked by the alerted observer and instructed to view the film as though they were involved in an operational search mission and did not have prior knowledge of target locations.

Computer data files were generated to summarize the results of the film analyses. Each file contained detection/miss data, target lateral ranges, search altitudes, target descriptors, and associated environmental conditions for each experiment day. These data files were sorted to examine the effects of search altitude, sea state, target type, and lateral range on target detection probability.

RESULTS

Table 2 summarizes the SAR target detection probabilities achieved by alerted operators. The data in Table 2 indicate that, while even very small life rafts were easily detected by the APS-135 in seas less than 1 meter, seas of 1 to 2 meters significantly diminished the detectability of targets smaller than a steel ship.

Table 3 summarizes the ice detection performance of the APS-135 SLAR. Alerted operators detected virtually all medium and most small iceberg targets in seas up to 2 meters. Detection of growlers was excellent in seas that averaged under 1 meter. Small icebergs (16 to 60 meters long) were detected in 1.1- to 1.8-meter seas more easily using 2500- and 4000-foot search altitudes and the 25-kilometer SLAR swath width (range scale) than using 8000-foot altitude and the 50-kilometer swath width.

TABLE 2

TARGET DETECTION PROBABILITIES FOR ALERTED OPERATOR/SAR TARGET DATA
(25-KILOMETER SWATH WIDTH)

TARGET TYPE	SEARCH ALTITUDES: 2500 and 4000 ft	
	H_S = 0.5 to 0.9 m	H_S = 1.0 to 1.8 m
1. EVERGREEN (55 meters, metal)	47/47 (1.00)	43/43 (1.00)
2. Ecco Radar Reflector (65-square meter radar cross section)	45/47 (0.96)	23/43 (0.53)
3. RHI Inflatable Outboard (5 meters, fiberglass/ rubber/metal)	46/47 (0.98)	9/25 (0.36)
4. B. F. Goodrich Life Raft (10-person canopied rubber raft)	34/47 (0.72)	5/40 (0.13)
5. Avon Life Raft (4-person canopied rubber raft)	20/47 (0.43)	0/43 (0.00)
NOTE: Ratios are number of detections/number of opportunities. Numbers in parentheses are target detection probabilities.		

TABLE 3

TARGET DETECTION PROBABILITIES FOR ALERTED OPERATOR/ICE TARGET DATA

TARGET TYPE	SEARCH ALTITUDE/SWATH WIDTH		
	2500 ft/25 km	4000 ft/25 km	8000 ft/50 km
Medium Iceberg (75 meters)	7/7 (1.00) Mean H_S = 0.8 m	6/6 (1.00) Mean H_S = 0.7 m	7/7 (1.00) Mean H_S = 0.6 m
Small Iceberg (24 to 60 meters)	41/42 (0.98) Mean H_S = 1.4 m	37/37 (1.00) Mean H_S = 1.4 m	34/39 (0.87) Mean H_S = 1.3 m
Growlers (3 to 15 meters)	20/21 (0.95) Mean H_S = 0.7 m	46/47 (0.98) Mean H_S = 0.7 m	10/11 (0.91) Mean H_S = 0.9 m
NOTE: Ratios are number of detections/number of opportunities. Numbers in parentheses are target detection probabilities.			

Table 4 summarizes the SAR target detection probabilities that could be expected from unalerted SLAR operators during operational searches. The probabilities in Table 4 were derived by multiplying the alerted operator detection probabilities from Table 2 by the fraction of targets that, if detected by alerted operators, could also be discerned by unalerted operators. The data in Table 4 indicate that, as sea state becomes high and target size becomes small, unalerted operators are less able to discriminate targets from background.

TABLE 4

EXPECTED TARGET DETECTION PROBABILITIES FOR UNALERTED SLAR OPERATORS

TARGET TYPE	SEARCH ALTITUDES: 2500 and 4000 ft	
	H_S = 0.5 to 0.9 m	H_S = 1.0 to 1.8 m
1. EVERGREEN (55 meters, metal)	~1.00	~1.00
2. Ecco Radar Reflector (65-square meter radar cross section)	0.92	0.35
3. RHI Inflatable Outboard (5 meters, fiberglass/ rubber/metal)	0.94	0.23
4. B. F. Goodrich Life Raft (10-person canopied rubber raft)	0.68	0.05
5. Avon Life Raft (4-person canopied rubber raft)	0.40	---

CONCLUSIONS

1. Alerted Operators -- SAR Targets

- The AN/APS-135 SLAR is capable of detecting ships nearly 100 percent of the time in seas up to at least 2 meters and ranges up to 50 kilometers.

- Targets as small as 5-meter boats with metal equipment (engine, gas tanks, frames, etc.) can be detected better than 90 percent of the time in seas less than 1 meter and 30 to 50 percent of the time in seas of 1 to 2 meters. These targets can be detected in low sea states out to the 50-kilometer swath width limit.

- Four- to ten-person rubber life rafts can be detected 40 to 70 percent of the time in seas less than 1 meter, but can be detected less than 15 percent of the time in seas of 1 to 2 meters.

- In seas less than 1 meter, the APS-135 SLAR detects small life rafts slightly better than the previously tested APS-94D Airborne Oil Surveillance System (AOSS) SLAR and about as well as the previously tested NASA APS-94C SLAR/Radar Image Processor (RIP) system.

- In seas less than 1 meter, the APS-135 appears* to detect small (5- to 6-meter) boats with metal equipment almost twice as well as the APS-94D AOSS system (98 percent versus 50 percent detection probability), and substantially better than the APS-94C SLAR/RIP (98 versus 69 percent detection probability).

*Some differences in characteristics exist between targets used in this versus previous evaluations.

2. Unalerted Operators -- SAR Targets

- o Unalerted APS-135 operators are capable of detecting ships nearly 100 percent of the time in seas up to 2 meters.

- o In seas under 1 meter, unalerted operators can achieve nearly the same target detection probabilities as alerted operators.

- o In seas of 1 to 2 meters, unalerted operators can detect about 65 percent of the small/medium vessels (as small as a 5-meter boat with metal equipment) that alerted operators can detect.

- o In seas of 1 to 2 meters, unalerted operators can detect only about one-third the number of life raft targets (10-person size) that alerted operators can detect.

- o It is highly unlikely that unalerted APS-135 operators have any significant capability of detecting small (e.g., four-person) life rafts in seas greater than 1 meter.

3. Alerted Operators -- Ice Targets

- o Medium (75-meter) icebergs are detectable nearly 100 percent of the time in seas up to at least 2 meters.

- o Small icebergs (24 to 60 meters) are detectable in seas of 1 to 2 meters nearly 100 percent of the time when search altitudes of 2500 to 4000 feet are used in conjunction with the 25-kilometer swath width. When 8000-foot search altitude and the 50-kilometer swath width are used, small icebergs are detectable approximately 87 percent of the time in seas of 1 to 2 meters.

- o Use of low altitude (2500 to 4000 feet) and 25-kilometer swath width may improve APS-135 detection of small icebergs and growlers when seas are above 1 meter. More data are required to confirm this conclusion.

- Based upon very limited data, small icebergs appear to be as detectable at lateral ranges between 25 and 50 kilometers as they are at ranges less than 25 kilometers (8000-foot search altitude/ 50-kilometer swath width assumed).

- Growlers are detectable greater than 90 percent of the time in seas less than 1 meter for 2500-, 4000-, and 8000-foot altitudes.

- In seas less than 1 meter, growlers appear to be as detectable at ranges of 25 to 50 kilometers as they are at ranges less than 25 kilometers.

- Iceberg detection performance achieved during this APS-135 SLAR evaluation was similar to that achieved by the system during BERGSEARCH '84. No direct comparison of growler detection performance was possible between the two experiments due to differences in sea state.

RECOMMENDATIONS

- Studies should be performed using trained SLAR operators and available surface-truthed film imagery to determine:

  1. The false alarm probabilities associated with unalerted operators searching for various SAR targets in low, moderate, and high sea states.

  2. The ability of SLAR operators to categorize SAR target contacts according to size and/or type.

- Additional data should be collected to determine the SAR target detection range limits, as a function of sea state, for the APS-135 operating on the 50-kilometer swath width.

- The concept of computerized digital SLAR image processing should be explored again to determine if state-of-the-art algorithms and hardware can be applied to accomplish:

  1. Discrimination of target signals from sea return.

  2. Classification of targets by size and/or type.

- Additional data should be collected to determine the influence of search altitude and swath width on ice target detection (especially of small icebergs and growlers) in seas higher than 1 meter.

ACKNOWLEDGEMENTS

The authors wish to express gratitude to LT. I. Anderson, MST1 K. O. Pelletier, MST3 W. A. Henry, the crew of USCGC EVERGREEN and the HC-130 aircrew of CG-1504. Their efforts resulted in collection of a complete set of data despite unpleasant weather and complicated logistics.

Chapter 1
INTRODUCTION

1.1 SCOPE

This report presents results of an evaluation of the AN/APS-135 side-looking airborne radar (SLAR) conducted by the U.S. Coast Guard Research and Development Center (R&D Center) in cooperation with the International Ice Patrol (IIP). In the Spring of 1985, an experiment was conducted in the North Atlantic Ocean off Newfoundland, Canada, to determine the ability of the APS-135 SLAR to detect icebergs, growlers (ice chunks less than or equal to 15 meters long), and various search and rescue (SAR) targets ranging from a small, 4-person life raft to a 180-foot (55-meter) Coast Guard cutter.

This work is a continuation of two previous SLAR evaluation efforts in which the Coast Guard has been involved. The first, conducted from 1978 to 1980, was an evaluation of the AN/APS-94C and AN/APS-94D SLARs (predecessors to the APS-135) in the SAR mission. The second, conducted in 1984 in cooperation with the Canadian government, was an evaluation of several SLARs (including the APS-135) in the ice detection role. This analysis will compare APS-135 SLAR detection performance achieved during the 1985 experiment with the performance achieved during the two previous studies. In addition, this study expands the number of SAR target types represented in the Coast Guard SLAR detection data base.

1.2 BACKGROUND

1.2.1 Previous SLAR Studies

Two previous Coast Guard SLAR evaluations are described in detail in References 1 through 5. A brief summary of each effort is provided below.

1.2.1.1 SAR Target Detection Evaluations

Four experiments that involved evaluation of SLAR as a SAR sensor were conducted by the Coast Guard R&D Center between 1978 and 1980. This effort was part of the Coast Guard's Improvement in Probability of Detection in Search and Rescue (POD/SAR) Project, assigned to the R&D Center, and is discussed in detail in References 1 through 3.

Two SLAR configurations were tested during the POD/SAR experiments. The first, a Motorola AN/APS-94D model installed on an HC-130B aircraft as part of the Airborne Oil Surveillance System (AOSS), was the Coast Guard's predecessor to the APS-135 system being evaluated in this report. The second system was a prototype developed by the National Aeronautics and Space Administration (NASA). This system incorporated a Motorola AN/APS-94C SLAR with a computerized digital radar image processor (RIP). The SLAR/RIP was also tested onboard a Coast Guard HC-130 aircraft.

Analysis of these experiments, summarized in Reference 2, indicated that SLAR provides an excellent (nearly 100 percent) capability to detect medium-sized surface vessels (with radar cross-sections of approximately 50 to 100 square meters) in seas up to 1.2 meters. With small fiberglass and aluminum boats up to 6 meters long and 4- to 6-person life rafts, the SLARs demonstrated limited detection capability (depending primarily on sea state, search altitude, and target type/range). The SLAR/RIP configuration, with its digital image processing and display capabilities, detected the small targets better than the AOSS SLAR did.

The SLAR/RIP prototype was never implemented as an operational system and is no longer available for testing. The AOSS SLAR has been replaced within the Coast Guard by the APS-135 system.

1.2.1.2 BERGSEARCH '84

During April 1984, a Coast Guard International Ice Patrol (IIP) HC-130 equipped with the APS-135 SLAR participated in an experiment sponsored by the

Canadian Environmental Studies Revolving Funds (ESRF). The objective of the BERGSEARCH '84 study was to assess the capabilities of five modern airborne imaging radars to detect ice targets in the open ocean. Targets used in this study consisted of various sizes of icebergs, including a smaller category called "bergy bits" (10 to 20 meters long). No SAR targets were considered in the analysis of the BERGSEARCH '84 data. The BERGSEARCH '84 research is discussed in detail in References 4 and 5.

The Coast Guard presently uses the APS-135 SLAR primarily for IIP ice reconnaissance, with SAR and oil spill surveillance as secondary mission applications. The BERGSEARCH '84 experiment provided the first opportunity for the IIP to compare SLAR ice imagery with surface truth data provided by an on-scene vessel and aerial photographic reconnaissance.

1.2.2 Description of AN/APS-135 SLAR and Comparison to Predecessors

The APS-135 SLAR is a significantly more powerful (200-kilowatt versus 45-kilowatt peak power) version of the predecessor APS-94 series of Motorola SLARs. In addition, some antenna parameter changes, which result in slightly different image characteristics, have been implemented on the IIP version of the APS-135. Significant system parameters are presented in Table 1-1.

The AOSS version of the APS-94D used split antennae, which provided somewhat different image characteristics on either side of the aircraft. A 2.4-meter, vertically polarized antenna mounted on the right side of the aircraft provided better detail in mapping sea-surface characteristics, such as waves, fronts, and oil slicks. The azimuthal beam width of the 2.4-meter antenna was approximately 0.90 degrees. A 4.8-meter horizontally polarized antenna, mounted on the left side of the aircraft, was optimized for detecting "hard" targets, such as ice and vessels. The azimuthal beam width of the left antenna was approximately 0.45 degrees.

The IIP version of the APS-135 SLAR employs two 4.8-meter antennae, which provide the narrower (0.47-degree) beamwidth for high resolution and are vertically polarized for depicting maximum surface detail. Output of the analog

TABLE 1-1

PRINCIPAL RADAR PARAMETERS FOR AN/APS-135

Peak Transmitter Power:	200 Kw
Frequency:	9250 MHz (center of 9210 to 9290 MHz tuning range)
Pulse Width:	0.2 microsecond
Pulse Repetition Frequency (PRF):	375 or 750 pulses per second*
Antenna Characteristics:	
Azimuthal half-power beamwidth:	0.47 degree, one-way
Elevation shaped pattern coverage:	-1.5 to -45 degrees
Peak gain:	38.3 dB (including radome loss)
Depression angle of beam peak:	1.5 degrees
Polarization:	Vertical
Receiver Noise Figure: (referred to GaAs FET preamplifier input)	5.22 dB
Receiver Bandwidth:	6 MHz
Transmitting Microwave Losses: (from magnetron to antenna)	3.96 dB
Receiving Microwave Losses: (from antenna to GaAs FET preamplifier input)	4.26 dB

*Effective PRF for each CRT. The actual transmitter PRF is either 750 or 1,500 pulses per second.

APS-135 imagery is provided on 23-centimeter wide, dry-process negative film. The AOSS SLAR employed an analog, wet-process, 23-centimeter film output.

The APS-135 SLAR is more powerful (at 200 kilowatts versus 45 kilowatts), but otherwise similar to the basic APS-94C. The APS-94C employed a single, 5.5-meter, horizontally polarized antenna with 0.45-degree beamwidth in azimuth. Instead of the analog negative film output, the SLAR/RIP configuration employed digital magnetic tape storage and false-color video display of the SLAR imagery. The RIP was equipped with computerized image enhancement algorithms that enabled the operator to maximize the target/background contrast of weaker returns. These digital image processing and display capabilities have not been implemented on the APS-135 system used by IIP.

1.2.3 Description of Targets

Two general types of targets were addressed during this evaluation: SAR and ice. The two target types are discussed in detail below.

1.2.3.1 SAR Targets

Five surface craft were used to represent a variety of potential SAR mission targets. These were:

1. Coast Guard Cutter EVERGREEN (WMEC 295). This vessel, a 180-foot (55-meter) converted buoy tender, was of metal construction. EVERGREEN provided all surface truth data concerning ice targets, environmental conditions, and the other SAR targets.

2. A 5-meter, rigid-hull, rubber inflatable (RHI) outboard manufactured by Avon. The rigid hull was made of fiberglass and was equipped with a metal towing frame. The boat was powered by two outboard motors and contained several metal fuel tanks. It is used as a general-purpose boat by EVERGREEN.

3. A four-person Avon life raft. This target was a circular rubber inflatable raft with a canopy. The diameter was 1.83 meters.

4. A 10-person B. F. Goodrich (BFG) life raft. This target was also a circular inflatable rubber raft with a canopy. The diameter was 2.8 meters.

5. A two-person Winslow life raft equipped with a standard radar target. The raft itself was not used as a primary target, but was used only to carry the standard radar target. The raft was an inflatable, rubber, oblong raft 2.2 meters long and 1 meter wide. The standard radar target consisted of two 180-degree Ecco reflectors manufactured by Emerson & Cumming, Inc. The reflectors were mounted back-to-back to give 360-degree coverage from all elevations. The reflectors were of a standard Luneberg lens design and provided a theoretical radar cross section of 65.3 square meters in the X-band.

1.2.3.2 Ice Targets

Three icebergs and several growlers were used as targets. They were classified by size according to IIP standards, including growler (up to 15-meter waterline length and <5-meter height); small berg (>15- to 60-meter length and 5- to 15-meter height); and medium (61- to 22-meter length and 16- to 45-meter height). The first iceberg, used on the 27 April test, was a medium drydock iceberg with maximum measurements of 75 meters x 58 meters x 18 meters. On this date, USCGC EVERGREEN also tracked seven growlers ranging from 3 to 10 meters long and approximately 1 to 2 meters high.

The second iceberg, a small drydock iceberg, was used as a target on the following dates: 1 May, 2 May, 4 May, and 5 May. During this five-day span, the iceberg, which started out in the upper end of the small size range (60 meters x 40 meters x 10 meters) diminished in size to 35 meters x 25 meters x 6 meters. Two growlers that calved during this deterioration process were used as targets on 1 May; one measured 15 meters x 6 meters x

2 meters and the other was 11 meters long and 2 meters high. On the final date of the experiment (5 May), a small iceberg (24 meters x 18 meters x 5 meters) was calved and used as a SLAR target.

1.2.4 Data Collection Procedures

1.2.4.1 General

Data for this evaluation were collected on 27 April and on 1, 2, 4, and 5 May 1985. The exact location of data collection varied with ice movement, but occurred in the general vicinity of 46°N, 48°W (approximately 400 kilometers southeast of St. Johns, Newfoundland). The general IIP operating area is depicted in Figure 1-1. IIP personnel onboard EVERGREEN were responsible for selecting iceberg targets using candidate iceberg positions provided by the SLAR aircraft. EVERGREEN then served as the key rendezvous point and surface staging platform for each day's data collection effort. Rendezvous positions were passed to the SLAR aircraft crew each morning via ship-to-shore telephone and/or teletype message.

During data collection runs, EVERGREEN stood 3 to 8 kilometers off the iceberg target and served as an alignment reference for flight track orientation (discussed below). All SAR targets were deployed and retrieved, as required, from the cutter. All surface target positions were referenced, via range and bearing, to the cutter's position. All target positions and required environmental data were recorded by the IIP crew onboard the cutter.

1.2.4.2 Target Deployment and SLAR Search Runs

SLAR search runs were conducted so that a number of passes were made at various ranges and altitudes relative to drifting targets. SAR targets were deployed when EVERGREEN was in proximity to suitable iceberg targets. The typical target arrangement is depicted in Figure 1-2.

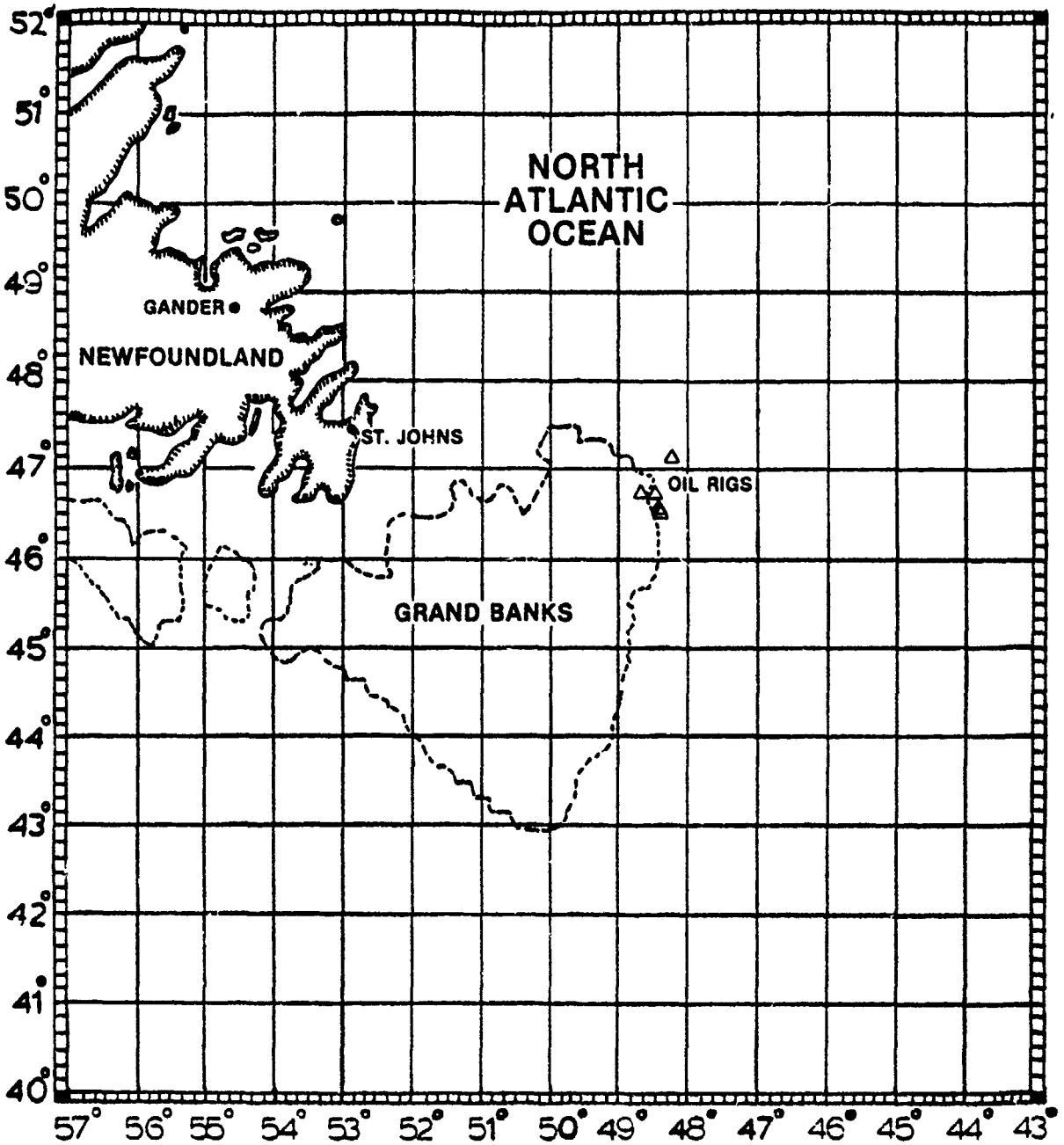


Figure 1-1. International Ice Patrol Operating Area

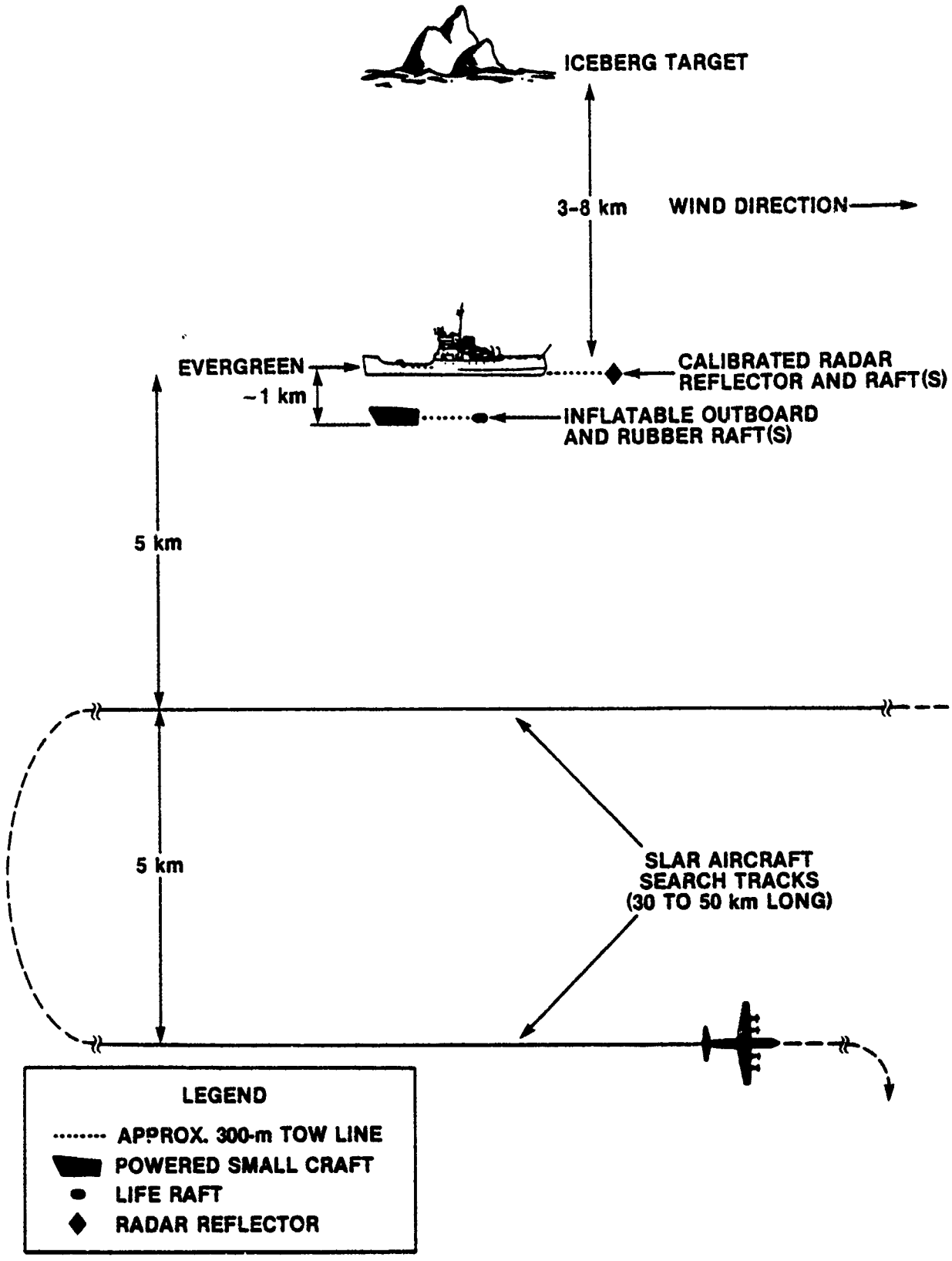


Figure 1-2. Desired Arrangement of SLAR Targets

Targets were deployed along a line running cross-wind from the iceberg target(s), while SLAR search tracks were flown in the upwind and downwind directions. This procedure minimized the amount of sea clutter interference on the SLAR imagery.

The two powered surface craft each towed life rafts and/or the radar reflector. When sea conditions prevented deployment of the rigid-hull inflatable craft, EVERGREEN towed all three unpowered targets, maintaining approximately 300 meters' separation between each of them.

The SLAR search runs were conducted in three segments as described in Table 1-2. The typical sequence of SLAR search tracks consisted of an inertial navigation system (INS) update; two sets of passes at 2500 feet (out and back); a climb to 4000 feet; a single set of passes at 4000 feet (out only); a climb to 8000 feet; two sets of passes at 8000 feet (out and back); descent to 4000 feet and an INS update; two sets of passes at 4000 feet (out and back); descent to 2500 feet; and one or two set(s) of passes at 2500 feet. This approach provided for a balanced data set over the range and altitude parameters.

TABLE 1-2
SLAR SEARCH RUN SEGMENTS

SEGMENT	TARGETS	ALTITUDES (ft)	TRACK SPACING (km)	DISPLAY SWATH WIDTH (km)	NOMINAL RANGES* (km)
1	Surface Craft and Icebergs	2500 and 4000	5	25	5, 10 15
2	Icebergs	8000	10	50	5, 15, 25, 35
3	Surface Craft and Icebergs	2500 and 4000	5	25	5, 10, 15
*Measured from the cutter EVERGREEN					

1.3 EXPERIMENT RECONSTRUCTION

Four sources of recorded data were used to reconstruct and describe each target detection opportunity. These were:

1. The 23-centimeter SLAR film recorded during the flybys of the targets.

2. SLAR Search Run Summary sheets that documented each flyby in terms of start and end times, airspeed, altitude, heading, range to EVERGREEN, and SLAR swath width in use.

3. Environmental Conditions Summary sheets that documented wind speed, significant wave height (H_S), and other environmental data of potential interest.

4. SLAR Target Position Records that documented the position of EVERGREEN in latitude/longitude and the positions of all other SAR and ice targets in range/true bearing from the cutter. Virtually all range/bearing data were obtained via radar fixes on the RHI and iceberg. Positions of the smaller targets were deduced from known tow line lengths and visual bearings.

During several weeks following the experiment, a team of R&D Center and IIP analysts correlated the manually recorded surface truth data with the SLAR film imagery to determine which of the documented targets were discernible on the film. Each target detection opportunity was recorded on raw data sheets with its associated lateral range (i.e., closest point of approach between target and SLAR aircraft), wind speed, H_S, SLAR swath width in use, search altitude, and target identifier. As each target detection opportunity was correlated with the SLAR film record, a detection or miss indicator (as appropriate) was recorded for it on the raw data sheet. Detections and misses recorded during this phase of the reconstruction were termed "alerted operator" data because the film analysis was done post-experiment using all available knowledge concerning target location on the film and the locations

of other targets. Thus, these data represent an upper bound on expected system detection performance because the film analyzers were highly alerted to target presence and location. The alerted data reflect the ability of the SLAR system to detect and record (however faintly or obscurely) a target. The ability of an unalerted operator to recognize the recorded detection on the film is not reflected in the alerted data.

To estimate the detection performance that might be achieved by an unalerted SLAR operator during IIP or SAR missions, an additional data recording phase was implemented. This second phase, termed "unalerted operator" film analysis, employed trained SLAR operators from Coast Guard Air Station Elizabeth City, North Carolina, to analyze the film. The unalerted operator analysis was performed using only those SAR targets that were considered detections in the alerted film analysis.

A total of five trained SLAR operators examined the film to determine which of the alerted SAR target detections would, in their estimation, have been recognized as a target during an operational SAR mission. It is emphasized that only those targets that were detected by the alerted operators were considered opportunities for the unalerted operator analysis. The operators were allowed to examine the overall film appearance for sea clutter and other extraneous contacts when evaluating each target. The operators were asked to ignore, to the extent possible, their biasing knowledge of target presence and approximate position when evaluating whether or not they would have detected the target in real time. The unalerted operator detection data were recorded and analyzed separately from the alerted operator data.

Iceberg reconnaissance differs from SAR in that iceberg target identification is based on post-flight analysis rather than real-time detection and verification. Therefore, the alerted operator analysis more closely approximates real IIP conditions, and no ice targets were evaluated during the unalerted operator analysis phase.

All detection and miss data (both alerted and unalerted) were entered into computer files from the raw data sheets for sorting and statistical analysis. Appendix A of this report contains copies of the raw data files.

1.4 ANALYSIS OBJECTIVES AND APPROACH

1.4.1 Introduction

Simple analytical techniques were generally used to examine the SLAR experiment data. These techniques consisted primarily of binning and/or plotting the empirical data to compare SLAR detection performance under sets of conditions that might demonstrate the influence of parameters such as H_S and altitude. Chi-square tests were then used to identify data sets that could be combined to larger sample sizes and reduce scatter in the detection probability statistics. Finally, the detection probabilities were compared using the Chi-square method to identify significant differences in target detectability.

1.4.2 Objectives

The primary objectives of the SLAR data analysis were to:

1. Evaluate the ability of the APS-135 SLAR to detect SAR targets,

2. Evaluate the ability of the APS-135 SLAR to detect icebergs and growlers,

3. Compare the results of the APS-135 SLAR evaluation to the results of previous Coast Guard APS-94 SLAR evaluations,

4. Compare the results of this APS-135 SLAR evaluation to those of BERGSEARCH '84, and

5. Obtain estimates of expected SLAR detection performance for actual SAR missions across a variety of target types.

1.4.3 Approach

The data were divided into two major categories: alerted and unalerted operator. Slightly different approaches were used to evaluate the two data groups. Both approaches included binning and plotting the empirical data and Chi-square tests to identify parameters that could be combined. The following subsections provide detailed descriptions of how each of the data sets was analyzed.

1.4.3.1 Alerted Operator -- SAR Targets

The alerted operator data for SAR targets were sorted on target type (5 total), search altitude (2500, 4000, and 8000 feet), significant wave height (H_S) (low -- 0.0 to 0.9 meter and high -- 0.9 to 1.8 meters), and lateral range (0.5 to 10.0 kilometers, >10.0 to 19.5 kilometers and >19.5 kilometers to range scale limit of 25 kilometers). After binning, the percent detected statistics for each data set were plotted as a function of lateral range.

For each target type, the detection percentages were plotted to compare low and high H_S detection performance at altitudes of 2500 feet and 4000 feet. Visual inspection of the plots indicated that the 2500- and 4000-foot altitudes could probably be combined at each H_S level for all five SAR target types. Chi-square tests at the 90-percent confidence level were performed to verify that this could be done; no statistically significant differences were found between the detection probabilities for the two altitudes. The data were combined and binned again, then plotted to compare the low and high H_S data for each target type. Finally, Chi-Square tests were used to identify significant differences between the detectability of the five target types.

1.4.3.2 Alerted Operator -- Icebergs and Growlers

The ice target data were sorted on size (growler, small iceberg, and medium iceberg) and search altitude. After detection probabilities had been computed, further analysis of the medium icebergs was not necessary because all were detected. The growler and small iceberg data were first sorted on target type and search altitude. The data collected using the 50-kilometer swath width were also sorted on lateral range into bins of $\leq$25 kilometers and >25 kilometers. The resultant detection probabilities were compared (taking sea state into consideration) to those achieved during the BERGSEARCH '84 experiment.

1.4.3.3 Unalerted Operator -- SAR Targets

The data for unalerted operators were sorted in the same way as were the data for alerted operators. No data for SAR targets at 8000-foot search altitude or for icebergs and growlers were included in this phase of the analysis. Chi-square tests again indicated that the 2500- and 4000-foot search altitude data could be combined.

For each of the five target types, the detection probabilities were computed and plotted to compare the low- and high-sea state detection performances of unalerted SLAR operators to those of alerted operators.

Chapter 2
RESULTS AND ANALYSIS

2.1 INTRODUCTION

This chapter describes the performance achieved by the APS-135 SLAR in detecting various SAR targets, icebergs, and growlers at different altitudes, sea states, and lateral ranges. Also, results of the 1985 experiment are compared to those previously achieved during the 1978 to 1980 POD/SAR experiments and the BERGSEARCH '84 evaluations.

2.2 SUMMARY OF DATA COLLECTED

The following subsections describe the quantities of data collected for alerted and unalerted operators and the range of environmental conditions encountered during the experiment.

2.2.1 Alerted Operator Data

Table 2-1 summarizes the number of detections and number of opportunities that occurred for alerted operator data.* The alerted operator data base contains both SAR and ice target data.

---

*An additional 83 detection opportunities occurred for SAR targets during iceberg search runs. These opportunities occurred during flybys that were conducted at 8000 feet using the 50-kilometer swath width. Most of these opportunities consisted of EVERGREEN, the radar reflector, or the raft(s) EVERGREEN was towing. These data will be included for information only in this report; statistically significant conclusions cannot be drawn because the data set is too small.

TABLE 2-1

SUMMARY OF ALERTED OPERATOR DATA

TARGET TYPE	TARGET	DETECTIONS/OPPORTUNITIES
SAR	EVERGREEN	90/90
	Emerson-Cumming Spherical Radar Reflector	68/90
	RHI Inflatable Outboard	55/72
	B. F. Goodrich Life Raft	39/87
	Avon Life Raft	20/90
ICE	Iceberg	132/138
	Growler	76/79

2.2.2 Unalerted Operator Data

Table 2-2 summarizes the number of unalerted operator detection opportunities obtained from the experiment data. No unalerted operator data were generated for the ice targets or for SAR targets at 8000-foot search altitude.

2.2.3 Range of Parameters

Table 2-3 summarizes the range of parameter values represented in the experiment data base. There are six parameters: target type, lateral range, search altitude, wind speed, significant wave height (H_S), and range scale. The parameters of primary interest were target type, lateral range, search altitude and H_S.

TABLE 2-2

SUMMARY OF UNALERTED OPERATOR DATA

TARGET TYPE	TARGET	DETECTIONS/OPPORTUNITIES
SAR	EVERGREEN	448/450
	Emerson-Cumming Spherical Radar Reflector	294/340
	RHI Inflatable Outboard	249/275
	B. F. Goodrich, Life Raft	171/195
	Avon Life Raft	92/98

TABLE 2-3

RANGE OF PARAMETERS INVESTIGATED DURING SLAR EXPERIMENT

TARGET TYPE	LATERAL RANGE (km)	SEARCH ALTITUDES (ft)	SIGNIFICANT WAVE HEIGHT (m)	WIND SPEED (m/sec)	RANGE SCALES (km)
SAR	0.6 to 45.0	2500 4000 8000	0.6 to 1.8	2.0 to 12.9	25 50*
ICE	0.6 to 47.0	2500 4000 8000	0.6 to 1.8	2.0 to 12.9	25 50

*Only limited SAR target data were collected at 8000 feet using the 50-kilometer range scale.

2.3 ANALYSIS OF SAR TARGET DATA

As described in Chapter 1, the SAR target detection data were analyzed in two major subgroups: alerted operator and unalerted operator. The following subsections provide a detailed discussion of the analysis performed on the two data sets and a comparison with APS-94 SLAR data.

2.3.1 SAR Targets -- Alerted Operators

The SAR target/alerted operator data were sorted on target type, search altitude, significant wave height, and lateral range as described in Section 1.4. Chi-square tests of the detection probabilities achieved for each target type indicated that, at the 90-percent confidence level, data collected at the 2500-foot and 4000-foot search altitudes could be combined; that is, there was no statistically significant difference in the target detection probabilities achieved using the two altitudes. Subsequently, the data were re-sorted using the three remaining parameters of target type, H_S, and lateral range. Figures 2-1 through 2-4 illustrate the resulting target detection probabilities as a function of lateral range. Data for EVERGREEN were not plotted because target detection probability was 100 percent in all cases.

The figures indicate that H_S (i.e., sea state) has a significant impact on target detection probability even with seas under 2 meters. The difference in target detection performance achieved in the two sea states was found to be significant at the 90-percent confidence level for all four target types. While small sample sizes in a few bins appear to have caused some unusual variations in target detection probability as a function of lateral range, it is clear that maximum target detection range was not approached using the 25-kilometer swath width except with the Avon life raft.

Overall target detection probabilities for the full 25-kilometer swath were computed for each target type/H_S combination and are summarized in Table 2-4. Chi-square tests were again used to compare these statistics among targets. When detection probabilities for the Ecco radar reflector and

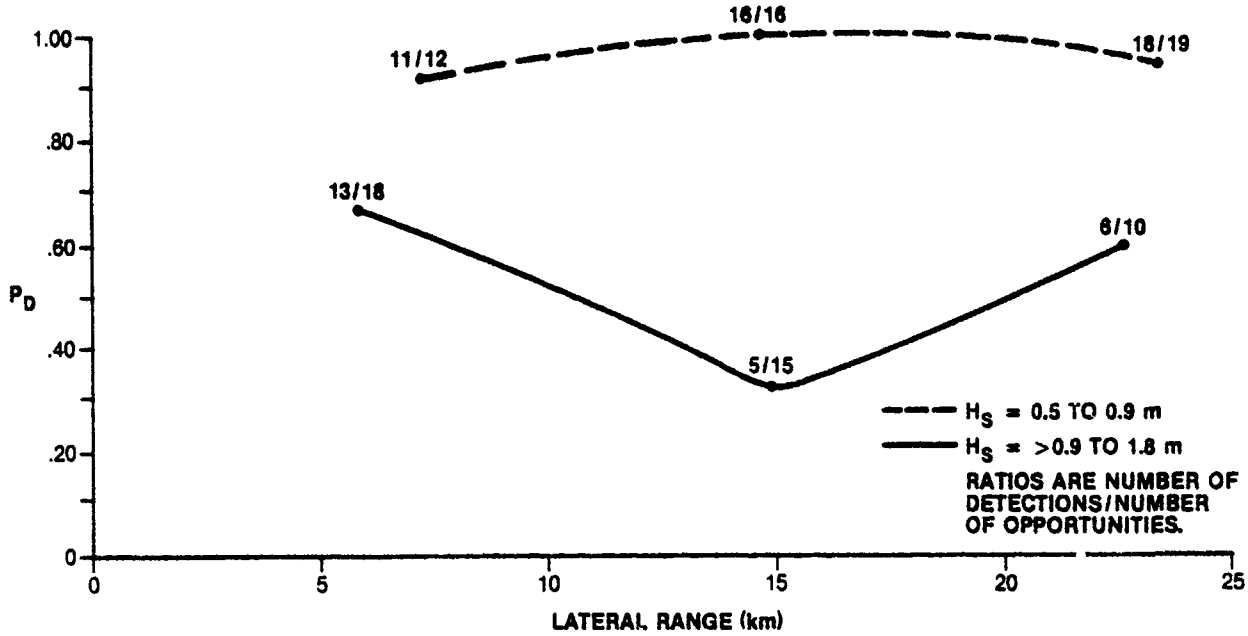


Figure 2-1. Target Detection Probability versus Lateral Range for Ecco Target with 65.3 m^2 Radar Cross Section

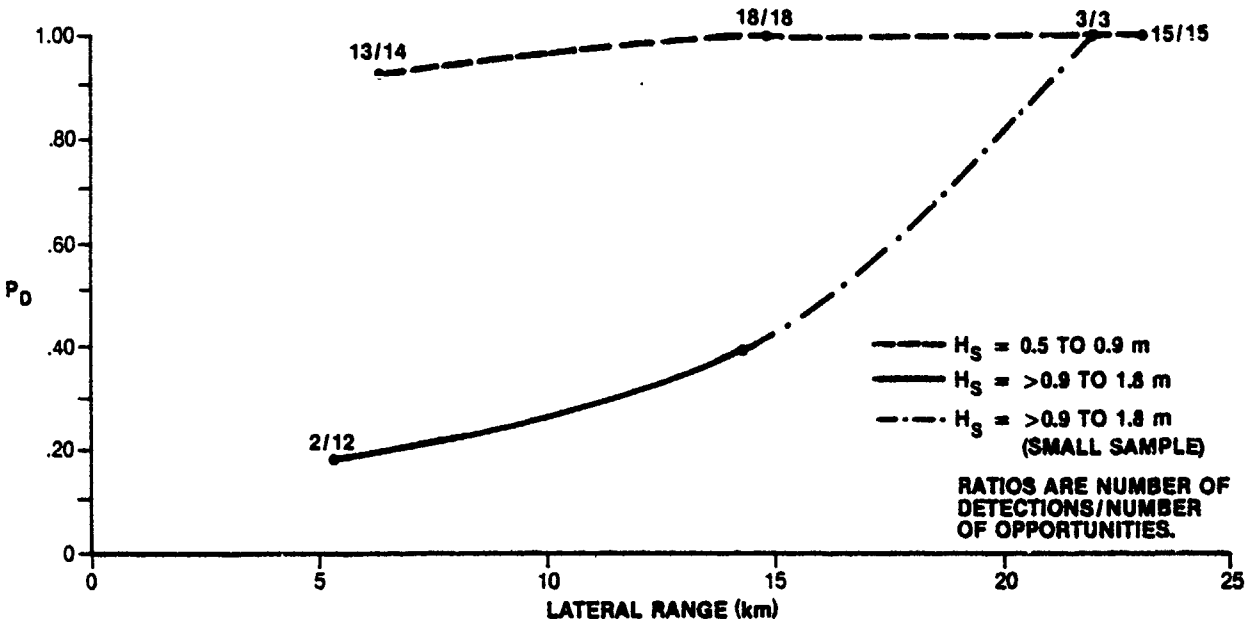


Figure 2-2. Target Detection Probability versus Lateral Range for 5-meter RHI Inflatable Outboard Target (Alerted Operators)

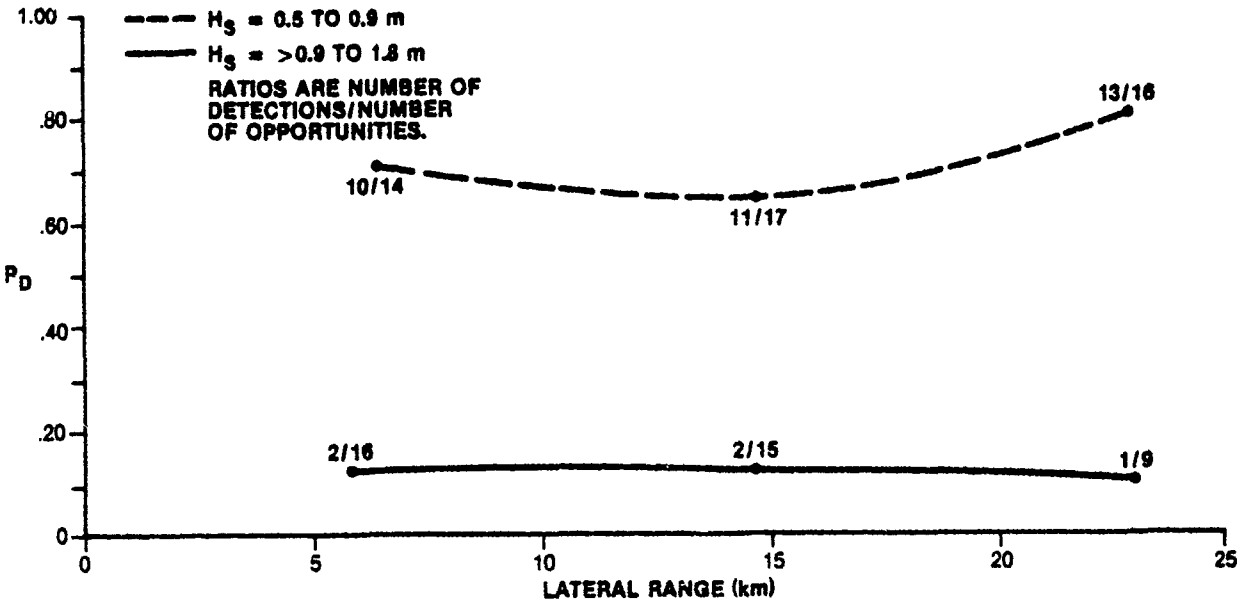


Figure 2-3. Target Detection Probability versus Lateral Range for 10-Person B. F. Goodrich Life Raft (Alerted Operators)

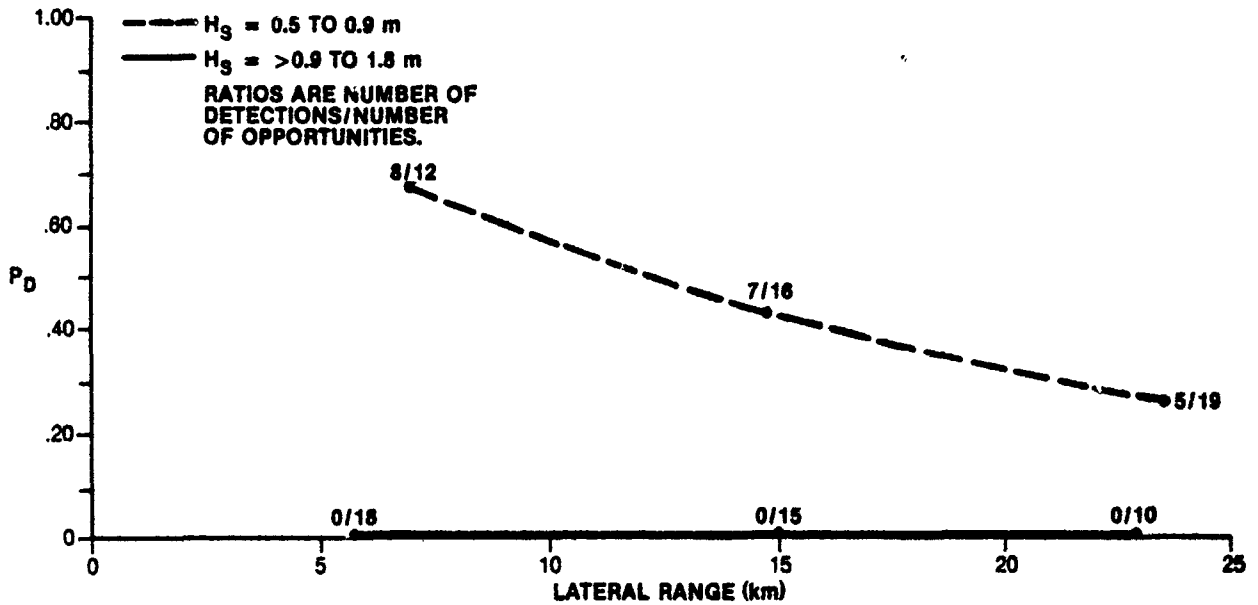


Figure 2-4. Target Detection Probability versus Lateral Range for Four-Person Avon Life Raft (Alerted Operators)

the RHI inflatable outboard were compared at the 90-percent confidence level, no significant difference in detectability was found in either sea state. Subsequent Chi-square tests indicated that these targets were significantly more detectable than the B. F. Goodrich life raft. In turn, the B. F. Goodrich life raft was found to be significantly more detectable than the Avon raft.

TABLE 2-4

TARGET DETECTION PROBABILITIES FOR ALERTED OPERATOR/SAR TARGET DATA (25-KILOMETER SWATH WIDTH)

TARGET TYPE	SEARCH ALTITUDES: 2500 and 4000 ft	
	H_S = 0.5 to 0.9 m	H_S = 1.0 to 1.8 m
1. EVERGREEN (55 meters, metal)	47/47 (1.00)	43/43 (1.00)
2. Ecco Radar Reflector (65-square meter radar cross section)	45/47 (0.96)	23/43 (0.53)
3. RHI Inflatable Outboard (5 meters, fiberglass/ rubber/metal)	46/47 (0.98)	9/25 (0.36)
4. B. F. Goodrich Life Raft (10-person canopied rubber raft)	34/47 (0.72)	5/40 (0.13)
5. Avon Life Raft (4-person canopied rubber raft)	20/47 (0.43)	0/43 (0.00)
NOTE: Ratios are number of detections/number of opportunities. Numbers in parentheses are target detection probabilities.		

Table 2-5 summarizes the small data set obtained with alerted operators and SAR targets using 8000-foot search altitude and the 50-kilometer range scale. These data are presented for information only and were not analyzed further due to the small sample sizes involved. The high detection rates achieved were probably an artifact of the small sample sizes and prevailing low sea state that characterize the data base.

TABLE 2-5

TARGET DETECTION STATISTICS FOR ALERTED OPERATOR/SAR TARGET DATA
(8000 FEET/50-KILOMETER SWATH WIDTH)

TARGET TYPE	LATERAL RANGES 0.5 to 25.0 km	LATERAL RANGES >25.0 to 50.0 km
1. EVERGREEN (55 meters, metal)	23/23 (1.00) Mean H_S = 1.2 m	17/17 (1.00) Mean H_S = 1.1 m
2. Ecco Radar Reflector (65-square meter radar cross section)	8/8 (1.00) Mean H_S = 0.8 m	7/7 (1.00) Mean H_S = 0.9 m
3. RHI Inflatable Outboard (5 meters, fiberglass/ rubber/metal)	2/2 (1.00) Mean H_S = 0.6 m	5/5 (1.00) Mean H_S = 0.7 m
4. B. F. Goodrich Life Raft (10-person canopied rubber raft)	4/4 (1.00) Mean H_S = 0.8 m	3/3 (1.00) Mean H_S = 0.6 m
5. Avon Life Raft 4-person canopied rubber raft)	3/8 (0.38) Mean H_S = 0.8 m	0/6 (0.00) Mean H_S = 0.7 m
NOTE: Ratios are number of detections/number of opportunities. Numbers in parentheses are target detection probabilities.		

2.3.2 SAR Targets -- Unalerted Operators

As described in Section 1.4, unalerted detection opportunities were generated using five trained SLAR operators. The operators were instructed to view the SLAR film and determine whether, under operational mission conditions, they would have detected,* the SAR targets that were detected by the alerted film analyzers. While some bias due to knowledge of target presence

*For this analysis, a detection was defined as a target on the film that would have caused the SLAR operator to request visual identification/ confirmation during a SAR mission; i.e., to divert the aircraft as necessary.

undoubtedly existed as the "unalerted" operators viewed the film, this analysis method provided the closest available estimate of expected SAR mission detection performance. No estimate of false alarm rate was obtained for this analysis.

Table 2-6 summarizes the unalerted target detection for the same data groups that were presented in Table 2-4. Note that the sample sizes (i.e., number of detection opportunities) in each data set shown in Table 2-6 are approximately five times the number of detections recorded in Table 2-4 due to the way in which the unalerted operator data were analyzed. The data in Table 2-6 indicate that, in seas under 1 meter, unalerted SLAR operators were able to distinguish nearly the same number of targets as the alerted operators. This is likely due to the absence of sea clutter on the SLAR

TABLE 2-6

TARGET DETECTION STATISTICS FOR UNALERTED OPERATOR/SAR TARGET DATA
(25-KILOMETER SWATH WIDTH)

TARGET TYPE	SEARCH ALTITUDES: 2500 and 4000 ft	
	H_S = 0.5 to 0.9 m	H_S = 1.0 to 1.8 m
1. EVERGREEN (55 meters, metal)	234/235 (~1.00)	214/215 (~1.00)
2. Ecco Radar Reflector (65-square meter radar cross section)	218/225 (0.96)	76/115 (0.66)
3. RHI Inflatable Outboard (5 meters, fiberglass/ rubber/metal)	220/230 (0.95)	29/45 (0.64)
4. B. F. Goodrich Life Raft (10-person canopied rubber raft)	162/170 (0.95)	9/25 (0.36)
5. Avon Life Raft (4-person canopied rubber raft)	92/98 (0.94)	---

NOTE: Ratios are number of detections/number of opportunities.
Numbers in parentheses are target detection probabilities.

imagery under these conditions, enabling even small targets to be distinguished from background. In seas of 1.0 to 1.8 meters, unalerted operators could distinguish the Ecco radar reflector only 66 percent of the times that it was detected by the alerted operators. Similarly, the RHI inflatable outboard could be distinguished only 64 percent of the time, and the B. F. Goodrich and Avon life rafts could be distinguished only 36 and 0 percent of the time, respectively. In contrast, all but one of the alerted EVERGREEN detections could also be distinguished by the unalerted operators in the higher sea state.

The unalerted operator analysis indicates that even light to moderate sea clutter can obscure surface targets smaller than a ship, even though the targets are detected and displayed by the SLAR. Table 2-7 lists the products that result from multiplying the alerted operator target detection percentages by the unalerted operator detection probabilities. The percentages

TABLE 2-7

EXPECTED TARGET DETECTION PROBABILITIES FOR UNALERTED SLAR OPERATORS

TARGET TYPE	SEARCH ALTITUDES: 2500 and 4000 ft	
	H_S = 0.5 to 0.9 m	H_S = 1.0 to 1.8 m
1. EVERGREEN (55 meters, metal)	~1.00	~1.00
2. Ecco Radar Reflector (65-square meter radar cross section)	0.92	0.35
3. RHI Inflatable Outboard (5 meters, fiberglass/ rubber/metal)	0.94	0.23
4. B. F. Goodrich Life Raft (10-person canopied rubber raft)	0.68	0.05
5. Avon Life Raft (4-person canopied rubber raft)	0.40	---

listed in Table 2-7 are, therefore, the actual target detection probabilities that could be expected on an operational SAR mission for the target types, sea conditions, search altitudes, and swath width specified. Again, it is emphasized that the probabilities listed in Table 2-7 may be somewhat optimistic. Even though they made every effort to remain objective, the five unalerted SLAR operators were slightly biased in their knowledge of target existence and approximate location.

2.3.3 Comparison with AN/APS-94 SLAR Detection Performance

Two target types used in this evaluation of the APS-135 SLAR are comparable to targets that were used in evaluating the APS-94D AOSS SLAR and APS-94C SLAR/RIP sensor configurations. The Avon four-person life raft is virtually identical to those used in the APS-94 evaluations, while the RHI outboard is somewhat comparable to some of the 5- to 6-meter fiberglass and aluminum boats used in the earlier tests. Table 2-8 compares the target detection probabilities achieved in seas less than 1 meter by the three SLAR systems and specifies the mean values of critical parameters associated with each data set. The data in Table 2-8 indicate that the APS-135, with its higher power and vertically polarized antennae, detects small life rafts somewhat more effectively than the AOSS SLAR and about as effectively as the SLAR/RIP in low sea states. With the small boat targets, it is not clear whether the large differences in detection performance between the APS-135 and its predecessors are due to differences in materials and construction between the RHI inflatable outboard and the outboard targets or due to a genuine difference in SLAR capability. It should be noted that the SLAR/RIP system, with its range processing capabilities, may have performed better in comparison to the APS-135 if data could be compared in higher sea states. Unfortunately, no appropriate data are available for such a comparison.

2.4 ANALYSIS OF ICE TARGET DATA

Iceberg and growler detection data were collected at search altitudes of 2500, 4000, and 8000 feet. The 2500- and 4000-foot data were collected

TABLE 2-8

DETECTION PERFORMANCE COMPARISON AMONG APS-135, APS-94D AOSS, AND APS-94C/RIP SLAR CONFIGURATIONS (ALERTED OPERATORS)

SLAR TYPE	TARGET TYPE	TARGET DETECTION PROBABILITY	MEAN H_S (m)	MEAN ALTITUDE (ft)	SWATH WIDTHS (km)
APS-135	4-Person Avon Raft	0.43	0.9	~3300	25
	5-Meter RHI	0.98	0.9	~3300	25
APS-94D AOSS	Small Rafts	0.30	0.4	~3100	25
	5- to 6-Meter Outboards	0.50	0.3	~3200	25
APS-94C/RIP	Small Rafts	0.48	0.3	~3400	25 & 50
	5- to 6-Meter Outboards	0.69	0.3	~3300	25 & 50

concurrently with SAR target data using the 25-kilometer swath width. The 8000-foot data runs were dedicated to ice detection using the 50-kilometer swath width although some SAR target data were also obtained. Growlers could be tracked by EVERGREEN personnel on only one and one-half of five experiment days; thus, the data quantities obtained are small for this target type. Frequently the SLAR was able to detect a large number of growlers in the study area, but EVERGREEN's surface search radar was unable to provide ground truth, particularly in higher sea states. The following subsections provide an analysis of the ice detection data and a comparison to BERGSEARCH '84 results.

2.4.1 Iceberg and Growler Detection Analysis

Table 2-9 summarizes the detection probabilities achieved with the ice targets. As the table indicates, the medium iceberg target was detected on all passes. These passes were made at lateral ranges between 10.4 and 22.8 kilometers at the 2500- and 4000-foot search altitudes (25-kilometer swath width), and at lateral ranges between 12.6 and 47.0 kilometers at the 8000-foot search altitude (50-kilometer swath width). The small iceberg

targets were detected on 78 of the 79 passes made at 2500- or 4000-foot altitude using the 25-kilometer swath width. At 8000 feet using the 50-kilometer swath width, 34 of 39 small iceberg opportunities were detected. Longer lateral ranges could not be linked to the slight drop in detection probability; in fact, 4 of the 5 targets missed in this data set occurred at ranges less than 25 kilometers. It is more likely that changes in target aspect, and/or the overall diminished display resolution of the 50-kilometer range scale, were responsible for the lower detection probability. All of the small iceberg detection opportunities occurred in seas of 0.9 to 1.8 meters.

Growler detection at the 2500- and 4000-foot search altitudes (25-kilometer swath width) was also excellent, with all but 2 of 68 targets detected. When the 8000-foot search altitude and 50-kilometer swath width were used, growlers were detected on 10 of the 11 opportunities that occurred. In contrast to the small iceberg data, H_S values were low (under 1 meter) for most of the growler detection opportunities. Variation of the growler detection probability with lateral range was also examined using the 8000-foot/50-kilometer swath width data. The data were sorted into lateral range bins of $\leq$25 kilometers and >25 to 50 kilometers. The resulting detection probabilities were 0.86 (5 of 6 opportunities) and 1.00 (5 of 5 opportunities), respectively. The difference between these detection probabilities

TABLE 2-9

TARGET DETECTION PROBABILITIES FOR ALERTED OPERATOR/ICE TARGET DATA

TARGET TYPE	SEARCH ALTITUDE/SWATH WIDTH		
	2500 ft/25 km	4000 ft/25 km	8000 ft/50 km
Medium Iceberg (75 meters)	7/7 (1.00) Mean H_S = 0.8 m	6/6 (1.00) Mean H_S = 0.7 m	7/7 (1.00) Mean H_S = 0.6 m
Small Iceberg (24 to 60 meters)	41/42 (0.98) Mean H_S = 1.4 m	37/37 (1.00) Mean H_S = 1.4 m	34/39 (0.87) Mean H_S = 1.3 m
Growlers (3 to 15 meters)	20/21 (0.95) Mean H_S = 0.7 m	46/47 (0.98) Mean H_S = 0.7 m	10/11 (0.91) Mean H_S = 0.9 m
NOTE: Ratios are number of detections/number of opportunities. Numbers in parentheses are target detection probabilities.			

was not significant at the 90-percent confidence level. Based on these very limited data, it appears that no significant variations in growler detection capability occurred over the 50-kilometer swath width.

2.4.2 Comparison to BERGSEARCH '84 Data

Growler and iceberg targets were included in the BERGSEARCH '84 data set collected by IIP using the APS-135 SLAR. The analysis of these data included computations of detection probability by target size, H_S, and search altitude. Table 2-10 summarizes the BERGSEARCH '84 statistics that are comparable to the detection probabilities given in Table 2-9 of this report.

TABLE 2-10

SUMMARY OF BERGSEARCH '84 DETECTION DATA
(ALERTED OPERATORS/25-KILOMETER SWATH WIDTH)

TARGET TYPE*	H_S(m)**			SEARCH ALTITUDE*** (ft)	
	<1.0	1.6-2.1	2.5-2.9	4000	8000
Medium Icebergs (50 to 100 meters)	23/24 (0.96)	---	---	---	---
Small Icebergs (20 to 50 meters)	10/12 (0.83)	15/16 (0.94)	8/8 (1.00)	4/4 (1.00)	11/12 (0.92)
Bergy Bits (10 to 20 meters)	10/12 (0.83)	23/32 (0.72)	24/36 (0.67)	7/8 (0.88)	16/24 (0.67)
Growlers (<10 meters)	0/2 (0.00)	4/32 (0.13)	1/24 (0.04)	1/8 (0.13)	3/24 (0.13)

*Site descriptions for ice target categories differ slightly for BERGSEARCH '84 data. These data were sorted in accordance with World Meteorological Organization (WMO) size classification and not the IIP standard.

**Both search altitudes

***H_S = 1.6 to 2.1 meters only

NOTE: Ratios are number of detections/number of opportunities. Numbers in parentheses are target detection probabilities.

Comparison of the iceberg statistics indicates that similar detection probabilities were achieved during the two experiments. The sample sizes of the BERGSEARCH '84 data were generally small, and no significant differences in iceberg detection probability could be found between the two experiments among cases where direct comparisons could legitimately be made.

The growler detection performance achieved during the 1985 experiment was clearly superior to that achieved in 1984. The only apparent explanation for this difference is that the 1985 data included H_S values of only 1 meter or less, and two bergy bits by the WMO sizing classification. The 1984 data were dominated by H_S values of 1.6 to 2.9 meters for ice targets less than 10 meters long. No significant variation in growler detection performance with altitude is indicated in either data base; H_S appears to dominate in influence.

Chapter 3
CONCLUSIONS AND RECOMMENDATIONS

3.1 CONCLUSIONS CONCERNING SAR TARGET DETECTION

The following conclusions are drawn based upon the analysis of SAR target data presented in Chapter 2.

3.1.1 Alerted Operator Detection Performance

The following conclusions refer to alerted operator film analysis in a post-flight laboratory environment. Thus, they reflect the APS-135 system's ability to detect and display targets, but not necessarily operational detection performance.

- The APS-135 SLAR is capable of detecting ships nearly 100 percent of the time in seas up to at least 2 meters and ranges up to 50 kilometers.

- Targets as small as 5-meter boats with metal equipment (engine, gas tank, frames, etc.) can be detected better than 90 percent of the time in seas less than 1 meter and 30 to 50 percent of the time in seas of 1 to 2 meters. These targets can be detected in low sea states out to the 50-kilometer swath width limit.

- Four- to ten-person rubber life rafts can be detected 40 to 70 percent of the time in sea less than 1 meter, but can be detected less than 15 percent of the time in seas of 1 to 2 meters.

- In seas less than 1 meter, the APS-135 SLAR detects small life rafts slightly better than the APS-94D AOSS SLAR and about as well as the APS-94C SLAR/RIP.

- o In seas less than 1 meter, the APS-135 appears* to detect small (5- to 6-meter) boats with metal equipment almost twice as well as the APS-94D AOSS system (98 percent versus 50 percent detection probability), and substantially better than the APS-94C SLAR/RIP (98 percent versus 69 percent detection probability).

- o A standard target such as the Ecco reflector (65.3-square meter radar cross section) provides a suitable target simulation for craft similar to the RHI inflatable outboard as it was equipped during this experiment.

3.1.2 Unalerted Operator Detection Performance

The conclusions in this section refer to film analysis by unalerted SLAR operators in a post-flight environment. Thus, they reflect the SLAR detection performance to be expected during operational SAR missions more closely than do the alerted operator conclusions.

- o Unalerted APS-135 operators are capable of detecting ships nearly 100 percent of the time in seas up to 2 meters.

- o In seas under 1 meter, unalerted operators can achieve nearly the same target detection probabilities as alerted operators with SAR targets as small as a four-person life raft.

- o In seas of 1 to 2 meters, unalerted operators can detect about 65 percent of the small/medium vessels (as small as a 5-meter boat with metal equipment) that alerted operators can detect. This equates to 20 to 35 percent of the total number of target detection opportunities.

---

*Some differences in characteristics exist between targets used in this versus previous evaluations.

- o In seas of 1 to 2 meters, unalerted operators can detect only about one-third the number of life raft targets (10-person size) that alerted operators can detect. This equates to approximately 5 percent of the total number of target detection opportunities.

- o It is highly unlikely that unalerted APS-135 operators have any significant capability of detecting small (e.g., four-person) life rafts in seas greater than 1 meter.

3.2 CONCLUSIONS CONCERNING ICE TARGET DETECTION

The following conclusions pertain to alerted operator film analysis in a post-flight environment. They reflect the APS-135 system's ability to detect and display ice targets, but not necessarily the real-time operator's ability to discern them.

- o Medium (75-meter) icebergs are detectable nearly 100 percent of the time in seas up to at least 2 meters.

- o Small icebergs (24 to 60 meters) are detectable in seas less than 2 meters about 90 percent of the time.

- o Based upon very limited data, small icebergs appear to be as detectable at lateral ranges between 25 and 50 kilometers as they are at ranges less than 25 kilometers (8000-foot search altitude/ 50-kilometer swath width assumed).

- o Use of low altitude (2500 to 4000 feet) and 25-kilometer swath width may improve APS-135 detection of small icebergs and growlers when seas are above 1 meter. More data are required to confirm this conclusion.

- o At all altitudes tested (2500, 4000, and 8000 feet), growlers are detectable greater than 90 percent of the time in seas less than 1 meter.

- o In seas less than 1 meter, growlers appear to be as detectable at ranges of 25 to 50 kilometers as they are at ranges less than 25 kilometers.

- o Iceberg detection performance achieved during this APS-135 SLAR evaluation was similar to that achieved by the system during BERGSEARCH '84. No direct comparison of growler detection performance was possible between the two experiments due to differences in sea state.

3.3 RECOMMENDATIONS

The following recommendations are made based on the results of this evaluation:

- o Since the APS-135 SLAR has demonstrated a capability to detect various SAR targets in seas up to at least 2 meters, studies should be performed using trained SLAR operators and available surface-truthed film imagery to determine:

    1. The target detection probabilities that can be achieved by completely unalerted operators searching for various SAR targets in low, moderate, and high sea states.

    2. The false alarm probabilities associated with unalerted operators searching for various SAR targets in low, moderate, and high sea states.

    3. The ability of SLAR operators to categorize SAR target contacts according to size and/or type.

- o Additional data should be collected to determine the SAR target detection range limits, as a function of sea state, for the APS-135 operating on the 50-kilometer swath width. These limits were not identified for targets larger than a 4-person raft when the 25-kilometer swath width was used.

- The concept of computerized digital SLAR image processing should be explored again to determine if state-of-the-art algorithms and hardware can be applied to accomplish:

  1. Discrimination of target signals from sea return.

  2. Classification of targets by size and/or type.

- Additional data should be collected to determine the influence of search altitude and swath width on ice target detection (especially of small icebergs and growlers) in seas higher than 1 meter.

REFERENCES

1. Edwards, N. C.; Osmer, S. R.; Mazour, T. J.; and Hover, G. L. Analysis of Side-Looking Airborne Radar Performance in the Detection of Search and Rescue Targets. Report No. CG-D-31-80. U. S. Coast Guard Research and Development Center and Analysis & Technology, Inc. March 1980.

2. Osmer, S. R.; Edwards, N. C., Jr.; Hover, G. L.; and Mazour, T. J. Evaluation of Two AN/APS-94 Side-Looking Airborne Radar Systems in the Detection of Search and Rescue Targets. Report No. CG-D-64-81. U. S. Coast Guard Research and Development Center and Analysis & Technology, Inc. August 1981.

3. Osmer, S. R.; Nash, L.; Hover, G. L.; and Mazour, T. J. Utilization of AN/APS-94 Side-Looking Airborne Radar System in Search and Rescue. Report No. CG-D-14-82. U. S. Coast Guard Research and Development Center and Analysis & Technology, Inc. April 1982.

4. Rossiter, J. R., et al. BERGSEARCH '84: Assessment of Airborne Imaging Radars for the Detection of Icebergs. Final Technical Report on Phase III - Data Analysis and Interpretation. CANPOLAR Consultants, Ltd. (Draft 1 - November 2, 1984).

5. Rossiter, J. R., et al. BERGSEARCH '84: Assessment of Airborne Imaging Radars for the Detection of Icebergs. Summary Report - Results, Conclusions, and Recommendations. CANPOLAR Consultants, Ltd. April 1985.

Appendix A
RAW DATA

This appendix contains raw data files for the SLAR detection data on a daily basis. Aggregate files were created for the alerted and unalerted operator data sets. Aggregate files were used in the binning of data and subsequent statistical analyses.

Page A-2 contains a key to the format of the data files.

Key for 1985 AN/APS-135 Data

Column 1: Number of possible detections
Column 2: Number of actual detections
Column 3: Lateral range (km)
Column 4: Wind speed (m/sec)
Column 5: H_S -- Significant wave height (meters)
Column 6: Range scale (km)
Column 7: Altitude (feet)
Column 8: Target type (target code - explained below)

Target Codes

3 = EVERGREEN
4 = Emerson-Cumming spherical radar reflector
5 = RHI inflatable outboard
6 = B. F. Goodrich life raft
7 = Avon life raft
11-15 = Growlers (3 to 15 meters)
20-21 = Small icebergs (24 to 60 meters)
30 = Medium iceberg (75 meters)

APS-135 27 APRIL 85 ALERTED

1	1	4.48	6.17	0.91	25.00	2500.00	3.00
1	1	4.48	6.17	0.91	25.00	2500.00	7.00
1	1	4.48	6.17	0.91	25.00	2500.00	4.00
1	1	4.11	6.17	0.91	25.00	2500.00	5.00
1	1	4.11	6.17	0.91	25.00	2500.00	6.00
1	1	10.42	6.17	0.91	25.00	2500.00	30.00
1	1	10.24	6.17	0.91	25.00	2500.00	3.00
1	1	10.24	6.17	0.91	25.00	2500.00	7.00
1	1	10.24	6.17	0.91	25.00	2500.00	4.00
1	1	9.78	6.17	0.91	25.00	2500.00	5.00
1	1	9.78	6.17	0.91	25.00	2500.00	6.00
1	1	16.64	6.17	0.91	25.00	2500.00	30.00
1	1	17.28	6.17	0.91	25.00	2500.00	3.00
1	0	17.28	6.17	0.91	25.00	2500.00	7.00
1	1	17.28	6.17	0.91	25.00	2500.00	4.00
1	1	16.18	6.17	0.91	25.00	2500.00	5.00
1	1	16.64	6.17	0.91	25.00	2500.00	6.00
1	1	22.86	6.17	0.91	25.00	2500.00	30.00
1	1	19.02	6.17	0.91	25.00	2500.00	3.00
1	0	19.02	6.17	0.91	25.00	2500.00	7.00
1	1	19.02	6.17	0.91	25.00	2500.00	4.00
1	1	18.20	6.17	0.91	25.00	2500.00	5.00
1	1	18.20	6.17	0.91	25.00	2500.00	6.00
1	1	13.81	6.17	0.91	25.00	2500.00	3.00
1	0	13.81	6.17	0.91	25.00	2500.00	7.00
1	1	13.81	6.17	0.91	25.00	2500.00	4.00
1	1	12.80	6.17	0.91	25.00	2500.00	5.00
1	1	12.80	6.17	0.91	25.00	2500.00	6.00
1	1	19.84	6.17	0.91	25.00	2500.00	30.00
1	1	7.32	6.17	0.91	25.00	2500.00	3.00
1	1	7.32	6.17	0.91	25.00	2500.00	7.00
1	1	7.32	6.17	0.91	25.00	2500.00	4.00
1	1	6.58	6.17	0.91	25.00	2500.00	5.00
1	1	6.58	6.17	0.91	25.00	2500.00	6.00
1	1	13.81	6.17	0.91	25.00	2500.00	30.00
1	1	5.94	6.17	0.91	25.00	4000.00	3.00
1	1	5.94	6.17	0.91	25.00	4000.00	7.00
1	1	5.94	6.17	0.91	25.00	4000.00	4.00
1	1	5.21	6.17	0.91	25.00	4000.00	5.00
1	1	5.21	6.17	0.91	25.00	4000.00	6.00
1	1	11.89	6.17	0.91	25.00	4000.00	30.00
1	1	11.16	6.17	0.91	25.00	4000.00	3.00
1	0	11.25	6.17	0.91	25.00	4000.00	7.00
1	1	11.25	6.17	0.91	25.00	4000.00	4.00
1	1	10.52	6.17	0.91	25.00	4000.00	5.00
1	1	10.52	6.17	0.91	25.00	4000.00	6.00
1	1	17.56	6.17	0.91	25.00	4000.00	30.00
1	1	16.92	5.14	0.61	25.00	4000.00	3.00
1	0	16.92	5.14	0.61	25.00	4000.00	7.00
1	1	16.92	5.14	0.61	25.00	4000.00	4.00
1	1	16.28	5.14	0.61	25.00	4000.00	5.00
1	1	16.28	5.14	0.61	25.00	4000.00	6.00

1	1	22.68	5.14	0.61	25.00	4000.00	30.00
1	1	22.22	5.14	0.61	25.00	4000.00	3.00
1	0	22.22	5.14	0.61	25.00	4000.00	7.00
1	1	22.22	5.14	0.61	25.00	4000.00	4.00
1	1	21.58	5.14	0.61	25.00	4000.00	5.00
1	1	21.58	5.14	0.61	25.00	4000.00	6.00
1	1	6.58	5.14	0.61	50.00	8000.00	3.00
1	1	6.58	5.14	0.61	50.00	8000.00	7.00
1	1	6.58	5.14	0.61	50.00	8000.00	4.00
1	1	12.62	5.14	0.61	50.00	8000.00	30.00
1	1	18.29	5.14	0.61	50.00	8000.00	3.00
1	0	18.29	5.14	0.61	50.00	8000.00	7.00
1	1	18.29	5.14	0.61	50.00	8000.00	4.00
1	1	17.37	5.14	0.61	50.00	8000.00	6.00
1	1	24.14	5.14	0.61	50.00	8000.00	30.00
1	1	31.09	5.14	0.61	50.00	8000.00	3.00
1	0	31.09	5.14	0.61	50.00	8000.00	7.00
1	1	31.09	5.14	0.61	50.00	8000.00	4.00
1	1	30.72	5.14	0.61	50.00	8000.00	5.00
1	1	30.72	5.14	0.61	50.00	8000.00	6.00
1	1	37.12	5.14	0.61	50.00	8000.00	30.00
1	1	41.88	5.14	0.61	50.00	8000.00	3.00
1	0	41.88	5.14	0.61	50.00	8000.00	7.00
1	1	41.88	5.14	0.61	50.00	8000.00	4.00
1	1	41.15	5.14	0.61	50.00	8000.00	5.00
1	1	47.00	5.14	0.61	50.00	8000.00	30.00
1	1	44.81	3.60	0.61	50.00	8000.00	3.00
1	0	44.81	3.60	0.61	50.00	8000.00	7.00
1	1	43.89	3.60	0.61	50.00	8000.00	5.00
1	1	43.89	3.60	0.61	50.00	8000.00	6.00
1	1	33.28	2.31	0.61	50.00	8000.00	3.00
1	0	33.28	2.31	0.61	50.00	8000.00	7.00
1	1	33.28	2.31	0.61	50.00	8000.00	4.00
1	1	32.37	2.31	0.61	50.00	8000.00	5.00
1	1	32.37	2.31	0.61	50.00	8000.00	6.00
1	1	39.32	2.31	0.61	50.00	8000.00	30.00
1	1	21.21	2.31	0.61	50.00	8000.00	3.00
1	0	21.21	2.31	0.61	50.00	8000.00	7.00
1	1	21.21	2.31	0.61	50.00	8000.00	4.00
1	1	20.12	2.31	0.61	50.00	8000.00	5.00
1	1	20.12	2.31	0.61	50.00	8000.00	6.00
1	1	28.16	2.31	0.61	50.00	8000.00	30.00
1	1	10.06	2.31	0.61	50.00	8000.00	3.00
1	0	10.06	2.31	0.61	50.00	8000.00	7.00
1	1	10.06	2.31	0.61	50.00	8000.00	4.00
1	1	9.14	2.31	0.61	50.00	8000.00	5.00
1	1	9.14	2.31	0.61	50.00	8000.00	6.00
1	1	15.73	2.31	0.61	50.00	8000.00	30.00
1	1	5.94	4.12	0.61	25.00	4000.00	3.00
1	1	6.13	4.12	0.61	25.00	4000.00	7.00
1	1	6.22	4.12	0.61	25.00	4000.00	4.00
1	1	5.12	4.12	0.61	25.00	4000.00	5.00
1	1	5.12	4.12	0.61	25.00	4000.00	6.00

1	1	12.98	4.12	0.61	25.00	4000.00	30.00
1	1	6.13	4.12	0.61	25.00	4000.00	11.00
1	1	5.21	4.12	0.61	25.00	4000.00	12.00
1	1	4.57	4.12	0.61	25.00	4000.00	13.00
1	1	4.21	4.12	0.61	25.00	4000.00	14.00
1	1	6.13	4.12	0.61	25.00	4000.00	15.00
1	1	11.34	4.12	0.61	25.00	4000.00	3.00
1	1	11.52	4.12	0.61	25.00	4000.00	7.00
1	1	11.70	4.12	0.61	25.00	4000.00	4.00
1	1	10.61	4.12	0.61	25.00	4000.00	5.00
1	1	10.61	4.12	0.61	25.00	4000.00	6.00
1	1	18.75	4.12	0.61	25.00	4000.00	30.00
1	1	11.61	4.12	0.61	25.00	4000.00	11.00
1	1	10.24	4.12	0.61	25.00	4000.00	12.00
1	1	9.97	4.12	0.61	25.00	4000.00	13.00
1	1	9.60	4.12	0.61	25.00	4000.00	14.00
1	1	11.89	4.12	0.61	25.00	4000.00	15.00
1	1	17.65	4.12	0.61	25.00	4000.00	3.00
1	0	17.74	4.12	0.61	25.00	4000.00	7.00
1	1	17.92	4.12	0.61	25.00	4000.00	4.00
1	1	16.46	4.12	0.61	25.00	4000.00	5.00
1	1	16.64	4.12	0.61	25.00	4000.00	6.00
1	1	17.74	4.12	0.61	25.00	4000.00	11.00
1	1	16.73	4.12	0.61	25.00	4000.00	12.00
1	1	16.18	4.12	0.61	25.00	4000.00	13.00
1	1	16.00	4.12	0.61	25.00	4000.00	14.00
1	1	17.92	4.12	0.61	25.00	4000.00	15.00
1	1	22.31	4.12	0.61	25.00	4000.00	3.00
1	1	22.31	4.12	0.61	25.00	4000.00	7.00
1	1	22.31	4.12	0.61	25.00	4000.00	4.00
1	1	21.31	4.12	0.61	25.00	4000.00	5.00
1	1	21.31	4.12	0.61	25.00	4000.00	6.00
1	1	22.49	4.12	0.61	25.00	4000.00	11.00
1	1	21.58	4.12	0.61	25.00	4000.00	12.00
1	1	21.03	4.12	0.61	25.00	4000.00	13.00
1	1	20.76	4.12	0.61	25.00	4000.00	14.00
1	1	22.22	3.09	0.61	25.00	4000.00	3.00
1	0	22.31	3.09	0.61	25.00	4000.00	7.00
1	1	22.49	3.09	0.61	25.00	4000.00	4.00
1	1	21.31	3.09	0.61	25.00	4000.00	5.00
1	1	21.31	3.09	0.61	25.00	4000.00	6.00
1	1	22.49	3.09	0.61	25.00	4000.00	11.00
1	1	21.67	3.09	0.61	25.00	4000.00	12.00
1	1	21.03	3.09	0.61	25.00	4000.00	14.00
1	1	22.59	3.09	0.61	25.00	4000.00	15.00
1	1	16.46	3.09	0.61	25.00	4000.00	3.00
1	0	16.64	3.09	0.61	25.00	4000.00	7.00
1	0	16.92	3.09	0.61	25.00	4000.00	4.00
1	1	15.54	3.09	0.61	25.00	4000.00	5.00
1	1	15.54	3.09	0.61	25.00	4000.00	6.00
1	1	17.10	3.09	0.61	25.00	4000.00	11.00
1	0	16.00	3.09	0.61	25.00	4000.00	12.00
1	1	13.72	3.09	0.61	25.00	4000.00	14.00

1	1	16.92	3.09	0.61	25.00	4000.00	15.00
1	1	11.52	3.09	0.61	25.00	4000.00	3.00
1	0	11.61	3.09	0.61	25.00	4000.00	7.00
1	1	11.80	3.09	0.61	25.00	4000.00	4.00
1	1	10.24	3.09	0.61	25.00	4000.00	5.00
1	0	10.33	3.09	0.61	25.00	4000.00	6.00
1	1	19.39	3.09	0.61	25.00	4000.00	30.00
1	1	11.89	3.09	0.61	25.00	4000.00	11.00
1	1	10.79	3.09	0.61	25.00	4000.00	12.00
1	1	9.97	3.09	0.61	25.00	4000.00	14.00
1	1	11.89	3.09	0.61	25.00	4000.00	15.00
1	1	5.49	3.09	0.61	25.00	2500.00	3.00
1	0	5.58	3.09	0.61	25.00	2500.00	7.00
1	1	5.67	3.09	0.61	25.00	2500.00	4.00
1	1	4.57	3.09	0.61	25.00	2500.00	5.00
1	1	4.57	3.09	0.61	25.00	2500.00	6.00
1	1	13.72	3.09	0.61	25.00	2500.00	30.00
1	1	5.85	3.09	0.61	25.00	2500.00	11.00
1	1	4.94	3.09	0.61	25.00	2500.00	12.00
1	1	4.66	3.09	0.61	25.00	2500.00	14.00
1	1	5.85	3.09	0.61	25.00	2500.00	15.00
1	1	10.06	3.09	0.61	25.00	2500.00	3.00
1	1	10.06	3.09	0.61	25.00	2500.00	7.00
1	1	10.06	3.09	0.61	25.00	2500.00	4.00
1	1	9.97	3.09	0.61	25.00	2500.00	5.00
1	1	9.97	3.09	0.61	25.00	2500.00	6.00
1	1	19.20	3.09	0.61	25.00	2500.00	30.00
1	1	11.43	3.09	0.61	25.00	2500.00	11.00
1	1	10.33	3.09	0.61	25.00	2500.00	12.00
1	1	10.06	3.09	0.61	25.00	2500.00	14.00
1	1	11.89	3.09	0.61	25.00	2500.00	15.00
1	1	17.37	3.09	0.61	25.00	2500.00	3.00
1	1	17.47	3.09	0.61	25.00	2500.00	7.00
1	1	17.56	3.09	0.61	25.00	2500.00	4.00
1	1	16.46	3.09	0.61	25.00	2500.00	5.00
1	1	16.46	3.09	0.61	25.00	2500.00	6.00
1	1	17.83	3.09	0.61	25.00	2500.00	11.00
1	1	16.92	3.09	0.61	25.00	2500.00	12.00
1	1	16.64	3.09	0.61	25.00	2500.00	14.00
1	1	17.92	3.09	0.61	25.00	2500.00	15.00
1	1	22.13	3.09	0.61	25.00	2500.00	3.00
1	0	22.13	3.09	0.61	25.00	2500.00	7.00
1	1	22.22	3.09	0.61	25.00	2500.00	4.00
1	1	21.21	3.09	0.61	25.00	2500.00	5.00
1	1	21.21	3.09	0.61	25.00	2500.00	6.00
1	0	23.32	3.09	0.61	25.00	2500.00	11.00
1	1	21.67	3.09	0.61	25.00	2500.00	12.00
1	1	21.03	3.09	0.61	25.00	2500.00	14.00
1	1	22.86	3.09	0.61	25.00	2500.00	15.00

APS-135 27 APRIL 85 UNALERTED

5	5	4.48	6.17	0.91	25.00	2500.00	3.00
5	5	4.48	6.17	0.91	25.00	2500.00	7.00
5	5	4.48	6.17	0.91	25.00	2500.00	4.00
5	5	4.11	6.17	0.91	25.00	2500.00	5.00
5	5	4.11	6.17	0.91	25.00	2500.00	6.00
5	5	10.24	6.17	0.91	25.00	2500.00	3.00
5	5	10.24	6.17	0.91	25.00	2500.00	7.00
5	5	10.24	6.17	0.91	25.00	2500.00	4.00
5	5	9.78	6.17	0.91	25.00	2500.00	5.00
5	5	9.78	6.17	0.91	25.00	2500.00	6.00
5	5	17.28	6.17	0.91	25.00	2500.00	3.00
5	5	17.28	6.17	0.91	25.00	2500.00	4.00
5	5	16.18	6.17	0.91	25.00	2500.00	5.00
5	5	16.64	6.17	0.91	25.00	2500.00	6.00
5	5	19.02	6.17	0.91	25.00	2500.00	3.00
5	5	19.02	6.17	0.91	25.00	2500.00	4.00
5	3	18.20	6.17	0.91	25.00	2500.00	5.00
5	3	18.20	6.17	0.91	25.00	2500.00	6.00
5	5	13.81	6.17	0.91	25.00	2500.00	3.00
5	5	13.81	6.17	0.91	25.00	2500.00	4.00
5	5	12.80	6.17	0.91	25.00	2500.00	5.00
5	5	12.80	6.17	0.91	25.00	2500.00	6.00
5	5	7.32	6.17	0.91	25.00	2500.00	3.00
5	5	7.32	6.17	0.91	25.00	2500.00	7.00
5	5	7.32	6.17	0.91	25.00	2500.00	4.00
5	5	6.58	6.17	0.91	25.00	2500.00	5.00
5	5	6.58	6.17	0.91	25.00	2500.00	6.00
5	5	5.94	6.17	0.91	25.00	4000.00	3.00
5	5	5.94	6.17	0.91	25.00	4000.00	7.00
5	5	5.94	6.17	0.91	25.00	4000.00	4.00
5	5	5.21	6.17	0.91	25.00	4000.00	5.00
5	5	5.21	6.17	0.91	25.00	4000.00	6.00
5	5	11.16	6.17	0.91	25.00	4000.00	3.00
5	5	11.25	6.17	0.91	25.00	4000.00	4.00
5	5	10.52	6.17	0.91	25.00	4000.00	5.00
5	5	10.52	6.17	0.91	25.00	4000.00	6.00
5	5	16.92	5.14	0.61	25.00	4000.00	3.00
5	5	16.92	5.14	0.61	25.00	4000.00	4.00
5	5	16.28	5.14	0.61	25.00	4000.00	5.00
5	5	16.28	5.14	0.61	25.00	4000.00	6.00
5	5	22.22	5.14	0.61	25.00	4000.00	3.00
5	5	22.22	5.14	0.61	25.00	4000.00	4.00
5	5	21.58	5.14	0.61	25.00	4000.00	5.00
5	4	21.58	5.14	0.61	25.00	4000.00	6.00
5	5	5.94	4.12	0.61	25.00	4000.00	3.00
5	5	6.13	4.12	0.61	25.00	4000.00	7.00
5	5	6.22	4.12	0.61	25.00	4000.00	4.00
5	5	5.12	4.12	0.61	25.00	4000.00	5.00
5	5	5.12	4.12	0.61	25.00	4000.00	6.00
5	5	11.34	4.12	0.61	25.00	4000.00	3.00
5	5	11.52	4.12	0.61	25.00	4000.00	7.00
5	5	11.70	4.12	0.61	25.00	4000.00	4.00

5	5	10.61	4.12	0.61	25.00	4000.00	5.00
5	5	10.61	4.12	0.61	25.00	4000.00	6.00
5	5	17.65	4.12	0.61	25.00	4000.00	3.00
5	5	17.92	4.12	0.61	25.00	4000.00	4.00
5	5	16.46	4.12	0.61	25.00	4000.00	5.00
5	5	16.64	4.12	0.61	25.00	4000.00	6.00
5	5	22.31	4.12	0.61	25.00	4000.00	3.00
5	4	22.31	4.12	0.61	25.00	4000.00	7.00
5	5	22.31	4.12	0.61	25.00	4000.00	4.00
5	5	21.31	4.12	0.61	25.00	4000.00	5.00
5	5	21.31	4.12	0.61	25.00	4000.00	6.00
5	5	22.22	3.09	0.61	25.00	4000.00	3.00
5	5	22.49	3.09	0.61	25.00	4000.00	4.00
5	5	21.31	3.09	0.61	25.00	4000.00	5.00
5	5	21.31	3.09	0.61	25.00	4000.00	6.00
5	5	16.46	3.09	0.61	25.00	4000.00	3.00
5	5	15.54	3.09	0.61	25.00	4000.00	5.00
5	5	15.54	3.09	0.61	25.00	4000.00	6.00
5	5	11.52	3.09	0.61	25.00	4000.00	3.00
5	5	11.80	3.09	0.61	25.00	4000.00	4.00
5	5	10.24	3.09	0.61	25.00	4000.00	5.00
5	5	5.49	3.09	0.61	25.00	2500.00	3.00
5	5	5.67	3.09	0.61	25.00	2500.00	4.00
5	5	4.57	3.09	0.61	25.00	2500.00	5.00
5	5	4.57	3.09	0.61	25.00	2500.00	6.00
5	5	10.06	3.09	0.61	25.00	2500.00	3.00
5	5	10.06	3.09	0.61	25.00	2500.00	7.00
5	5	10.06	3.09	0.61	25.00	2500.00	4.00
5	5	9.97	3.09	0.61	25.00	2500.00	5.00
5	5	9.97	3.09	0.61	25.00	2500.00	6.00
5	5	17.37	3.09	0.61	25.00	2500.00	3.00
5	4	17.47	3.09	0.61	25.00	2500.00	7.00
5	5	17.56	3.09	0.61	25.00	2500.00	4.00
5	5	16.46	3.09	0.61	25.00	2500.00	5.00
5	5	16.46	3.09	0.61	25.00	2500.00	6.00
5	5	22.13	3.09	0.61	25.00	2500.00	3.00
5	5	22.22	3.09	0.61	25.00	2500.00	4.00
5	5	21.21	3.09	0.61	25.00	2500.00	5.00
5	5	21.21	3.09	0.61	25.00	2500.00	6.00

APS-135 1 MAY 85 ALERTED

1	1	5.85	4.12	0.91	25.00	2500.00	3.00
1	1	5.85	4.12	0.91	25.00	2500.00	7.00
1	1	5.85	4.12	0.91	25.00	2500.00	4.00
1	1	5.03	4.12	0.91	25.00	2500.00	5.00
1	1	5.03	4.12	0.91	25.00	2500.00	6.00
1	1	10.06	4.12	0.91	25.00	2500.00	20.00
1	1	11.16	4.12	0.91	25.00	2500.00	3.00
1	1	11.16	4.12	0.91	25.00	2500.00	7.00
1	1	11.16	4.12	0.91	25.00	2500.00	4.00
1	1	10.24	4.12	0.91	25.00	2500.00	5.00
1	1	10.24	4.12	0.91	25.00	2500.00	6.00
1	1	15.91	4.12	0.91	25.00	2500.00	20.00
1	1	17.56	4.12	0.91	25.00	2500.00	3.00
1	1	17.56	4.12	0.91	25.00	2500.00	7.00
1	1	17.56	4.12	0.91	25.00	2500.00	4.00
1	1	16.55	4.12	0.91	25.00	2500.00	5.00
1	1	16.55	4.12	0.91	25.00	2500.00	6.00
1	1	21.67	4.12	0.91	25.00	2500.00	20.00
1	1	17.10	3.60	0.91	25.00	2500.00	3.00
1	1	17.10	3.60	0.91	25.00	2500.00	7.00
1	1	17.10	3.60	0.91	25.00	2500.00	4.00
1	1	16.18	3.60	0.91	25.00	2500.00	5.00
1	1	16.18	3.60	0.91	25.00	2500.00	6.00
1	1	21.49	3.60	0.91	25.00	2500.00	20.00
1	1	14.26	3.60	0.91	25.00	2500.00	11.00
1	1	11.61	3.60	0.91	25.00	2500.00	3.00
1	0	11.61	3.60	0.91	25.00	2500.00	7.00
1	1	11.61	3.60	0.91	25.00	2500.00	4.00
1	1	10.42	3.60	0.91	25.00	2500.00	5.00
1	1	10.42	3.60	0.91	25.00	2500.00	6.00
1	1	16.46	3.60	0.91	25.00	2500.00	20.00
1	1	5.21	3.60	0.91	25.00	2500.00	3.00
1	1	5.12	3.60	0.91	25.00	2500.00	7.00
1	1	5.03	3.60	0.91	25.00	2500.00	4.00
1	1	4.21	3.60	0.91	25.00	2500.00	5.00
1	1	4.11	3.60	0.91	25.00	2500.00	6.00
1	1	9.60	3.60	0.91	25.00	2500.00	20.00
1	1	5.39	3.60	0.91	25.00	4000.00	3.00
1	0	5.39	3.60	0.91	25.00	4000.00	7.00
1	1	5.49	3.60	0.91	25.00	4000.00	4.00
1	1	4.11	3.60	0.91	25.00	4000.00	5.00
1	1	4.11	3.60	0.91	25.00	4000.00	6.00
1	1	9.42	3.60	0.91	25.00	4000.00	20.00
1	1	11.16	3.60	0.91	25.00	4000.00	3.00
1	1	10.97	3.60	0.91	25.00	4000.00	7.00
1	1	10.88	3.60	0.91	25.00	4000.00	4.00
1	1	9.69	3.60	0.91	25.00	4000.00	5.00
1	1	9.69	3.60	0.91	25.00	4000.00	6.00
1	1	15.36	3.60	0.91	25.00	4000.00	20.00
1	1	18.38	3.60	0.91	25.00	4000.00	3.00
1	0	18.29	3.60	0.91	25.00	4000.00	7.00
1	1	18.20	3.60	0.91	25.00	4000.00	4.00

1	1	17.01	3.60	0.91	25.00	4000.00	5.00
1	1	16.92	3.60	0.91	25.00	4000.00	6.00
1	1	21.85	3.60	0.91	25.00	4000.00	20.00
1	1	16.55	3.60	0.91	25.00	4000.00	11.00
1	1	22.77	3.60	0.91	25.00	4000.00	3.00
1	0	22.59	3.60	0.91	25.00	4000.00	7.00
1	1	22.49	3.60	0.91	25.00	4000.00	4.00
1	1	21.76	3.60	0.91	25.00	4000.00	5.00
1	1	21.49	3.60	0.91	25.00	4000.00	6.00
1	1	21.03	3.60	0.91	25.00	4000.00	11.00
1	1	7.32	3.60	0.91	50.00	8000.00	3.00
1	1	6.95	3.60	0.91	50.00	8000.00	7.00
1	1	6.95	3.60	0.91	50.00	8000.00	4.00
1	1	10.24	3.60	0.91	50.00	8000.00	20.00
1	1	5.12	3.60	0.91	50.00	8000.00	11.00
1	1	16.28	4.12	0.91	50.00	8000.00	3.00
1	1	16.09	4.12	0.91	50.00	8000.00	7.00
1	1	15.91	4.12	0.91	50.00	8000.00	4.00
1	1	18.84	4.12	0.91	50.00	8000.00	20.00
1	1	14.26	4.12	0.91	50.00	8000.00	11.00
1	1	29.81	4.12	0.91	50.00	8000.00	3.00
1	0	29.81	4.12	0.91	50.00	8000.00	7.00
1	1	29.81	4.12	0.91	50.00	8000.00	4.00
1	1	32.00	4.12	0.91	50.00	8000.00	20.00
1	1	27.80	4.12	0.91	50.00	8000.00	11.00
1	1	38.40	4.12	0.91	50.00	8000.00	3.00
1	1	40.60	4.12	0.91	50.00	8000.00	20.00
1	1	36.94	4.12	0.91	50.00	8000.00	11.00
1	1	42.79	4.12	0.91	50.00	8000.00	3.00
1	1	44.44	4.12	0.91	50.00	8000.00	20.00
1	1	41.70	4.12	0.91	50.00	8000.00	11.00
1	1	29.99	4.12	0.91	50.00	8000.00	3.00
1	0	30.18	4.12	0.91	50.00	8000.00	7.00
1	1	30.36	4.12	0.91	50.00	8000.00	4.00
1	1	33.47	4.12	0.91	50.00	8000.00	20.00
1	1	30.36	4.12	0.91	50.00	8000.00	11.00
1	1	25.05	2.06	0.91	50.00	8000.00	12.00
1	1	19.20	2.06	0.91	50.00	8000.00	3.00
1	0	19.39	2.06	0.91	50.00	8000.00	7.00
1	1	19.57	2.06	0.91	50.00	8000.00	4.00
1	1	23.77	2.06	0.91	50.00	8000.00	20.00
1	1	20.12	2.06	0.91	50.00	8000.00	11.00
1	0	14.63	2.06	0.91	50.00	8000.00	12.00
1	1	5.67	2.06	0.91	50.00	8000.00	3.00
1	0	5.85	2.06	0.91	50.00	8000.00	7.00
1	1	6.04	2.06	0.91	50.00	8000.00	4.00
1	1	10.42	2.06	0.91	50.00	8000.00	20.00
1	1	7.86	2.06	0.91	50.00	8000.00	11.00
1	1	2.74	2.06	0.91	50.00	8000.00	12.00
1	1	4.02	2.06	0.91	25.00	4000.00	3.00
1	1	4.30	2.06	0.91	25.00	4000.00	7.00
1	1	4.57	2.06	0.91	25.00	4000.00	4.00

1	1	3.02	2.06	0.91	25.00	4000.00	5.00
1	0	2.47	2.06	0.91	25.00	4000.00	6.00
1	1	9.69	2.06	0.91	25.00	4000.00	20.00
1	1	8.23	2.06	0.91	25.00	4000.00	11.00
1	1	2.01	2.06	0.91	25.00	4000.00	12.00
1	1	8.50	2.06	0.91	25.00	4000.00	3.00
1	0	8.69	2.06	0.91	25.00	4000.00	7.00
1	1	8.96	2.06	0.91	25.00	4000.00	4.00
1	1	7.59	2.06	0.91	25.00	4000.00	5.00
1	1	7.77	2.06	0.91	25.00	4000.00	6.00
1	1	14.90	2.06	0.91	25.00	4000.00	20.00
1	1	12.62	2.06	0.91	25.00	4000.00	11.00
1	1	7.04	2.06	0.91	25.00	4000.00	12.00
1	1	15.54	2.06	0.91	25.00	4000.00	3.00
1	1	15.82	2.06	0.91	25.00	4000.00	7.00
1	1	16.00	2.06	0.91	25.00	4000.00	4.00
1	1	14.63	2.06	0.91	25.00	4000.00	5.00
1	1	14.81	2.06	0.91	25.00	4000.00	6.00
1	1	20.94	2.06	0.91	25.00	4000.00	20.00
1	1	19.20	2.06	0.91	25.00	4000.00	11.00
1	1	13.72	2.06	0.91	25.00	4000.00	12.00
1	1	21.12	2.06	0.91	25.00	4000.00	3.00
1	1	21.40	2.06	0.91	25.00	4000.00	7.00
1	1	21.58	2.06	0.91	25.00	4000.00	4.00
1	1	19.66	2.06	0.91	25.00	4000.00	5.00
1	1	19.66	2.06	0.91	25.00	4000.00	6.00
1	1	18.84	2.06	0.91	25.00	4000.00	12.00
1	1	21.67	2.06	0.91	25.00	4000.00	3.00
1	0	21.85	2.06	0.91	25.00	4000.00	7.00
1	1	22.13	2.06	0.91	25.00	4000.00	4.00
1	1	21.03	2.06	0.91	25.00	4000.00	5.00
1	0	21.31	2.06	0.91	25.00	4000.00	6.00
1	1	20.76	2.06	0.91	25.00	4000.00	12.00
1	1	16.09	2.06	0.91	25.00	4000.00	3.00
1	0	16.37	2.06	0.91	25.00	4000.00	7.00
1	1	16.64	2.06	0.91	25.00	4000.00	4.00
1	1	15.27	2.06	0.91	25.00	4000.00	5.00
1	0	15.27	2.06	0.91	25.00	4000.00	6.00
1	1	22.40	2.06	0.91	25.00	4000.00	20.00
1	1	20.76	2.06	0.91	25.00	4000.00	11.00
1	1	15.18	2.06	0.91	25.00	4000.00	12.00
1	1	10.97	2.06	0.91	25.00	4000.00	3.00
1	0	11.25	2.06	0.91	25.00	4000.00	7.00
1	1	11.61	2.06	0.91	25.00	4000.00	4.00
1	1	9.97	2.06	0.91	25.00	4000.00	5.00
1	0	9.97	2.06	0.91	25.00	4000.00	6.00
1	1	18.29	2.06	0.91	25.00	4000.00	20.00
1	1	16.37	2.06	0.91	25.00	4000.00	11.00
1	1	9.88	2.06	0.91	25.00	4000.00	12.00
1	1	4.21	2.06	0.91	25.00	4000.00	3.00
1	0	4.48	2.06	0.91	25.00	4000.00	7.00
1	1	4.75	2.06	0.91	25.00	4000.00	4.00
1	0	3.29	2.06	0.91	25.00	4000.00	5.00

1	0	3.29	2.06	0.91	25.00	4000.00	6.00
1	1	11.34	2.06	0.91	25.00	4000.00	20.00
1	1	9.14	2.06	0.91	25.00	4000.00	11.00
1	1	3.47	2.06	0.91	25.00	4000.00	12.00
1	1	9.14	4.12	0.91	25.00	2500.00	3.00
1	1	8.96	4.12	0.91	25.00	2500.00	7.00
1	1	8.87	4.12	0.91	25.00	2500.00	4.00
1	1	7.68	4.12	0.91	25.00	2500.00	5.00
1	1	7.68	4.12	0.91	25.00	2500.00	6.00
1	1	16.18	4.12	0.91	25.00	2500.00	20.00
1	1	14.63	4.12	0.91	25.00	2500.00	11.00
1	1	7.86	4.12	0.91	25.00	2500.00	12.00
1	1	16.18	4.12	0.91	25.00	2500.00	3.00
1	0	16.09	4.12	0.91	25.00	2500.00	7.00
1	1	16.00	4.12	0.91	25.00	2500.00	4.00
1	1	14.72	4.12	0.91	25.00	2500.00	5.00
1	0	14.54	4.12	0.91	25.00	2500.00	6.00
1	1	22.49	4.12	0.91	25.00	2500.00	20.00
1	1	20.57	4.12	0.91	25.00	2500.00	11.00
1	1	14.63	4.12	0.91	25.00	2500.00	12.00

APS-135 1 MAY 85 UNALERTED

5	5	5.85	4.12	0.91	25.00	2500.00	3.00
5	5	5.85	4.12	0.91	25.00	2500.00	7.00
5	5	5.85	4.12	0.91	25.00	2500.00	4.00
5	5	5.03	4.12	0.91	25.00	2500.00	5.00
5	5	5.03	4.12	0.91	25.00	2500.00	6.00
5	5	11.16	4.12	0.91	25.00	2500.00	3.00
5	5	11.16	4.12	0.91	25.00	2500.00	7.00
5	5	11.16	4.12	0.91	25.00	2500.00	4.00
5	5	10.24	4.12	0.91	25.00	2500.00	5.00
5	5	10.24	4.12	0.91	25.00	2500.00	6.00
5	5	17.56	4.12	0.91	25.00	2500.00	3.00
5	4	17.56	4.12	0.91	25.00	2500.00	7.00
5	5	17.56	4.12	0.91	25.00	2500.00	4.00
5	5	16.55	4.12	0.91	25.00	2500.00	5.00
5	5	16.55	4.12	0.91	25.00	2500.00	6.00
5	5	17.10	3.60	0.91	25.00	2500.00	3.00
5	4	17.10	3.60	0.91	25.00	2500.00	7.00
5	5	17.10	3.60	0.91	25.00	2500.00	4.00
5	5	16.18	3.60	0.91	25.00	2500.00	5.00
5	5	16.18	3.60	0.91	25.00	2500.00	6.00
5	5	11.61	3.60	0.91	25.00	2500.00	3.00
5	5	11.61	3.60	0.91	25.00	2500.00	4.00
5	5	10.42	3.60	0.91	25.00	2500.00	5.00
5	4	10.42	3.60	0.91	25.00	2500.00	6.00
5	5	5.21	3.60	0.91	25.00	2500.00	3.00
5	5	5.12	3.60	0.91	25.00	2500.00	7.00
5	5	5.03	3.60	0.91	25.00	2500.00	4.00
5	5	4.21	3.60	0.91	25.00	2500.00	5.00
5	5	4.11	3.60	0.91	25.00	2500.00	6.00
5	5	5.39	3.60	0.91	25.00	4000.00	3.00
5	5	5.49	3.60	0.91	25.00	4000.00	4.00
5	5	4.11	3.60	0.91	25.00	4000.00	5.00
5	5	4.11	3.60	0.91	25.00	4000.00	6.00
5	5	11.16	3.60	0.91	25.00	4000.00	3.00
5	5	10.97	3.60	0.91	25.00	4000.00	7.00
5	5	10.88	3.60	0.91	25.00	4000.00	4.00
5	5	9.69	3.60	0.91	25.00	4000.00	5.00
5	4	9.69	3.60	0.91	25.00	4000.00	6.00
5	5	18.38	3.60	0.91	25.00	4000.00	3.00
5	5	18.20	3.60	0.91	25.00	4000.00	4.00
5	5	17.01	3.60	0.91	25.00	4000.00	5.00
5	5	16.92	3.60	0.91	25.00	4000.00	6.00
5	5	22.77	3.60	0.91	25.00	4000.00	3.00
5	5	22.49	3.60	0.91	25.00	4000.00	4.00
5	5	21.76	3.60	0.91	25.00	4000.00	5.00
5	5	21.49	3.60	0.91	25.00	4000.00	6.00
5	5	4.02	2.06	0.91	25.00	4000.00	3.00
3	1	4.30	2.06	0.91	25.00	4000.00	7.00
5	5	4.57	2.06	0.91	25.00	4000.00	4.00
5	5	3.02	2.06	0.91	25.00	4000.00	5.00
5	5	8.50	2.06	0.91	25.00	4000.00	3.00
5	5	8.96	2.06	0.91	25.00	4000.00	4.00

5	2	7.59	2.06	0.91	25.00	4000.00	5.00
5	2	7.77	2.06	0.91	25.00	4000.00	6.00
5	5	15.54	2.06	0.91	25.00	4000.00	3.00
5	3	15.82	2.06	0.91	25.00	4000.00	7.00
5	5	16.00	2.06	0.91	25.00	4000.00	4.00
5	5	14.63	2.06	0.91	25.00	4000.00	5.00
5	5	14.81	2.06	0.91	25.00	4000.00	6.00
5	5	21.12	2.06	0.91	25.00	4000.00	3.00
5	5	21.40	2.06	0.91	25.00	4000.00	7.00
5	5	21.58	2.06	0.91	25.00	4000.00	4.00
5	5	19.66	2.06	0.91	25.00	4000.00	5.00
5	5	19.66	2.06	0.91	25.00	4000.00	6.00
5	5	21.67	2.06	0.91	25.00	4000.00	3.00
5	5	22.13	2.06	0.91	25.00	4000.00	4.00
5	5	21.03	2.06	0.91	25.00	4000.00	5.00
5	5	16.09	2.06	0.91	25.00	4000.00	3.00
5	5	16.64	2.06	0.91	25.00	4000.00	4.00
5	4	15.27	2.06	0.91	25.00	4000.00	5.00
5	4	10.97	2.06	0.91	25.00	4000.00	3.00
5	5	11.61	2.06	0.91	25.00	4000.00	4.00
5	5	9.97	2.06	0.91	25.00	4000.00	5.00
5	5	4.21	2.06	0.91	25.00	4000.00	3.00
5	5	4.75	2.06	0.91	25.00	4000.00	4.00
5	5	9.14	4.12	0.91	25.00	2500.00	3.00
5	4	8.96	4.12	0.91	25.00	2500.00	7.00
5	5	8.87	4.12	0.91	25.00	2500.00	4.00
5	5	7.68	4.12	0.91	25.00	2500.00	5.00
5	5	7.68	4.12	0.91	25.00	2500.00	6.00
5	5	16.18	4.12	0.91	25.00	2500.00	3.00
5	5	16.00	4.12	0.91	25.00	2500.00	4.00
5	5	14.72	4.12	0.91	25.00	2500.00	5.00

APS-135 2 MAY 85 ALERTED

1	1	1.83	8.23	1.68	25.00	2500.00	3.00
1	0	1.92	8.23	1.68	25.00	2500.00	7.00
1	0	2.01	8.23	1.68	25.00	2500.00	4.00
1	0	0.64	8.23	1.68	25.00	2500.00	5.00
1	0	0.73	8.23	1.68	25.00	2500.00	6.00
1	1	4.30	8.23	1.68	25.00	2500.00	20.00
1	1	6.58	8.23	1.68	25.00	2500.00	3.00
1	0	6.77	8.23	1.68	25.00	2500.00	7.00
1	1	6.95	8.23	1.68	25.00	2500.00	4.00
1	1	9.05	8.23	1.68	25.00	2500.00	20.00
1	1	11.80	8.23	1.68	25.00	2500.00	3.00
1	0	11.89	8.23	1.68	25.00	2500.00	7.00
1	0	11.98	8.23	1.68	25.00	2500.00	4.00
1	0	10.61	8.23	1.68	25.00	2500.00	5.00
1	0	10.61	8.23	1.68	25.00	2500.00	6.00
1	1	14.72	8.23	1.68	25.00	2500.00	20.00
1	1	12.44	8.23	1.68	25.00	2500.00	3.00
1	0	12.62	8.23	1.68	25.00	2500.00	7.00
1	0	12.80	8.23	1.68	25.00	2500.00	4.00
1	0	11.34	8.23	1.68	25.00	2500.00	5.00
1	0	11.34	8.23	1.68	25.00	2500.00	6.00
1	1	11.34	8.23	1.68	25.00	2500.00	20.00
1	1	6.95	8.23	1.68	25.00	2500.00	3.00
1	0	6.95	8.23	1.68	25.00	2500.00	7.00
1	1	6.95	8.23	1.68	25.00	2500.00	4.00
1	0	6.86	8.23	1.68	25.00	2500.00	5.00
1	0	6.86	8.23	1.68	25.00	2500.00	6.00
1	1	9.42	8.23	1.68	25.00	2500.00	20.00
1	1	1.55	8.23	1.68	25.00	2500.00	3.00
1	0	1.65	8.23	1.68	25.00	2500.00	7.00
1	0	1.74	8.23	1.68	25.00	2500.00	4.00
1	0	0.64	8.23	1.68	25.00	2500.00	5.00
1	0	0.64	8.23	1.68	25.00	2500.00	6.00
1	1	4.11	8.23	1.68	25.00	2500.00	20.00
1	1	4.48	8.23	1.52	25.00	4000.00	3.00
1	0	4.39	8.23	1.52	25.00	4000.00	7.00
1	0	4.39	8.23	1.52	25.00	4000.00	4.00
1	0	3.38	8.23	1.52	25.00	4000.00	5.00
1	0	3.38	8.23	1.52	25.00	4000.00	6.00
1	1	6.77	8.23	1.52	25.00	4000.00	20.00
1	1	9.33	8.23	1.52	25.00	4000.00	3.00
1	0	9.51	8.23	1.52	25.00	4000.00	7.00
1	0	9.60	8.23	1.52	25.00	4000.00	4.00
1	1	8.32	8.23	1.52	25.00	4000.00	5.00
1	0	8.32	8.23	1.52	25.00	4000.00	6.00
1	1	11.70	8.23	1.52	25.00	4000.00	20.00
1	1	14.81	8.23	1.52	25.00	4000.00	3.00
1	0	15.09	8.23	1.52	25.00	4000.00	7.00
1	0	14.63	8.23	1.52	25.00	4000.00	4.00
1	1	13.81	8.23	1.52	25.00	4000.00	5.00
1	0	13.81	8.23	1.52	25.00	4000.00	6.00
1	1	17.01	8.23	1.52	25.00	4000.00	20.00

1	1	1.83	8.23	1.22	50.00	8000.00	3.00
1	1	3.47	8.23	1.22	50.00	8000.00	20.00
1	1	10.97	8.23	1.22	50.00	8000.00	3.00
1	1	13.17	8.23	1.22	50.00	8000.00	20.00
1	1	24.14	8.23	1.22	50.00	8000.00	3.00
1	1	27.07	8.23	1.22	50.00	8000.00	20.00
1	1	34.38	8.23	1.22	50.00	8000.00	3.00
1	1	36.94	8.23	1.22	50.00	8000.00	20.00
1	1	40.42	6.69	1.22	50.00	8000.00	3.00
1	1	42.98	6.69	1.22	50.00	8000.00	20.00
1	1	24.87	6.69	1.22	50.00	8000.00	3.00
1	1	25.42	6.69	1.22	50.00	8000.00	4.00
1	1	29.81	6.69	1.22	50.00	8000.00	20.00
1	1	15.18	6.69	1.22	50.00	8000.00	3.00
1	1	18.47	6.69	1.22	50.00	8000.00	20.00
1	1	2.38	6.69	1.22	50.00	8000.00	3.00
1	1	5.30	6.69	1.22	50.00	8000.00	20.00
1	1	7.68	4.63	0.91	25.00	4000.00	3.00
1	0	7.86	4.63	0.91	25.00	4000.00	7.00
1	0	8.05	4.63	0.91	25.00	4000.00	4.00
1	1	7.32	4.63	0.91	25.00	4000.00	5.00
1	0	7.32	4.63	0.91	25.00	4000.00	6.00
1	1	11.43	4.63	0.91	25.00	4000.00	20.00
1	1	13.81	4.63	0.91	25.00	4000.00	3.00
1	0	13.99	4.63	0.91	25.00	4000.00	7.00
1	1	14.17	4.63	0.91	25.00	4000.00	4.00
1	1	13.44	4.63	0.91	25.00	4000.00	5.00
1	0	13.44	4.63	0.91	25.00	4000.00	6.00
1	1	17.74	4.63	0.91	25.00	4000.00	20.00
1	1	19.75	4.12	0.91	25.00	4000.00	3.00
1	0	19.93	4.12	0.91	25.00	4000.00	7.00
1	1	20.12	4.12	0.91	25.00	4000.00	4.00
1	1	18.93	4.12	0.91	25.00	4000.00	5.00
1	0	18.93	4.12	0.91	25.00	4000.00	6.00
1	1	23.13	4.12	0.91	25.00	4000.00	20.00
1	1	19.84	4.12	0.91	25.00	2500.00	3.00
1	0	20.03	4.12	0.91	25.00	2500.00	7.00
1	1	20.30	4.12	0.91	25.00	2500.00	4.00
1	1	19.29	4.12	0.91	25.00	2500.00	5.00
1	0	19.02	4.12	0.91	25.00	2500.00	6.00
1	1	23.41	4.12	0.91	25.00	2500.00	20.00
1	1	13.17	4.12	0.91	25.00	2500.00	3.00
1	0	13.35	4.12	0.91	25.00	2500.00	7.00
1	1	13.53	4.12	0.91	25.00	2500.00	4.00
1	1	12.62	4.12	0.91	25.00	2500.00	5.00
1	0	12.53	4.12	0.91	25.00	2500.00	6.00
1	1	17.74	4.12	0.91	25.00	2500.00	20.00
1	1	7.04	4.12	0.91	25.00	2500.00	3.00
1	1	7.22	4.12	0.91	25.00	2500.00	7.00
1	1	7.41	4.12	0.91	25.00	2500.00	4.00
1	1	6.68	4.12	0.91	25.00	2500.00	5.00
1	0	6.58	4.12	0.91	25.00	2500.00	6.00
1	1	11.89	4.12	0.91	25.00	2500.00	20.00

APS-135 2 MAY 85 UNALERTED

5	5	1.83	8.23	1.68	25.00	2500.00	3.00
5	5	6.58	8.23	1.68	25.00	2500.00	3.00
5	2	6.95	8.23	1.68	25.00	2500.00	4.00
5	5	11.80	8.23	1.68	25.00	2500.00	3.00
5	5	12.44	8.23	1.68	25.00	2500.00	3.00
5	5	6.95	8.23	1.68	25.00	2500.00	3.00
5	1	6.95	8.23	1.68	25.00	2500.00	4.00
5	5	1.55	8.23	1.68	25.00	2500.00	3.00
5	5	4.48	8.23	1.52	25.00	4000.00	3.00
5	5	9.33	8.23	1.52	25.00	4000.00	3.00
5	5	8.32	8.23	1.52	25.00	4000.00	5.00
5	5	14.81	8.23	1.52	25.00	4000.00	3.00
5	3	13.81	8.23	1.52	25.00	4000.00	5.00
5	5	7.68	4.63	0.91	25.00	4000.00	3.00
5	5	7.32	4.63	0.91	25.00	4000.00	5.00
5	5	13.81	4.63	0.91	25.00	4000.00	3.00
5	0	14.17	4.63	0.91	25.00	4000.00	4.00
5	5	13.44	4.63	0.91	25.00	4000.00	5.00
5	5	19.75	4.12	0.91	25.00	4000.00	3.00
5	4	20.12	4.12	0.91	25.00	4000.00	4.00
5	1	18.93	4.12	0.91	25.00	4000.00	5.00
5	5	19.84	4.12	0.91	25.00	2500.00	3.00
5	4	20.30	4.12	0.91	25.00	2500.00	4.00
5	5	19.29	4.12	0.91	25.00	2500.00	5.00
5	5	13.17	4.12	0.91	25.00	2500.00	3.00
5	5	13.53	4.12	0.91	25.00	2500.00	4.00
5	5	12.62	4.12	0.91	25.00	2500.00	5.00
5	5	7.04	4.12	0.91	25.00	2500.00	3.00
5	5	7.22	4.12	0.91	25.00	2500.00	7.00
5	5	7.41	4.12	0.91	25.00	2500.00	4.00
5	5	6.63	4.12	0.91	25.00	2500.00	5.00

APS-135 4 MAY 85 ALERTED,

1	1	12.80	9.26	1.37	25.00	2500.00	3.00
1	0	12.80	9.26	1.37	25.00	2500.00	7.00
1	0	12.80	9.26	1.37	25.00	2500.00	4.00
1	0	12.80	9.26	1.37	25.00	2500.00	6.00
1	1	16.28	9.26	1.37	25.00	2500.00	20.00
1	1	19.02	9.26	1.37	25.00	2500.00	3.00
1	0	18.93	9.26	1.37	25.00	2500.00	7.00
1	0	18.93	9.26	1.37	25.00	2500.00	4.00
1	0	18.93	9.26	1.37	25.00	2500.00	6.00
1	1	21.67	9.26	1.37	25.00	2500.00	20.00
1	1	20.39	10.80	1.37	25.00	2500.00	3.00
1	0	20.03	10.80	1.37	25.00	2500.00	7.00
1	0	19.84	10.80	1.37	25.00	2500.00	4.00
1	0	20.21	10.80	1.37	25.00	2500.00	6.00
1	1	23.32	10.80	1.37	25.00	2500.00	20.00
1	1	14.26	10.80	1.37	25.00	2500.00	3.00
1	0	14.17	10.80	1.37	25.00	2500.00	7.00
1	0	14.08	10.80	1.37	25.00	2500.00	4.00
1	0	14.17	10.80	1.37	25.00	2500.00	6.00
1	1	17.56	10.80	1.37	25.00	2500.00	20.00
1	1	8.23	10.80	1.37	25.00	2500.00	3.00
1	0	8.23	10.80	1.37	25.00	2500.00	7.00
1	1	8.23	10.80	1.37	25.00	2500.00	4.00
1	0	8.23	10.80	1.37	25.00	2500.00	6.00
1	1	11.89	10.80	1.37	25.00	2500.00	20.00
1	1	2.38	10.80	1.37	25.00	2500.00	3.00
1	0	2.38	10.80	1.37	25.00	2500.00	7.00
1	1	2.38	10.80	1.37	25.00	2500.00	4.00
1	0	2.38	10.80	1.37	25.00	2500.00	6.00
1	1	5.94	10.80	1.37	25.00	2500.00	20.00
1	1	4.94	10.80	1.37	25.00	4000.00	3.00
1	0	4.94	10.80	1.37	25.00	4000.00	7.00
1	1	4.94	10.80	1.37	25.00	4000.00	4.00
1	1	4.94	10.80	1.37	25.00	4000.00	6.00
1	1	8.87	10.80	1.37	25.00	4000.00	20.00
1	1	10.97	10.80	1.37	25.00	4000.00	3.00
1	0	10.97	10.80	1.37	25.00	4000.00	7.00
1	1	10.97	10.80	1.37	25.00	4000.00	4.00
1	1	10.97	10.80	1.37	25.00	4000.00	6.00
1	1	15.18	10.80	1.37	25.00	4000.00	20.00
1	1	17.37	10.80	1.37	25.00	4000.00	3.00
1	0	17.37	10.80	1.37	25.00	4000.00	7.00
1	1	17.37	10.80	1.37	25.00	4000.00	4.00
1	0	17.37	10.80	1.37	25.00	4000.00	6.00
1	1	11.89	10.80	1.37	25.00	4000.00	20.00
1	1	11.70	10.80	1.52	50.00	8000.00	3.00
1	1	11.70	10.80	1.52	50.00	8000.00	6.00
1	1	15.73	10.80	1.52	50.00	8000.00	20.00
1	1	12.44	10.80	1.52	50.00	8000.00	3.00
1	1	17.01	10.80	1.52	50.00	8000.00	20.00
1	1	35.48	11.83	1.52	50.00	8000.00	3.00
1	1	39.32	11.83	1.52	50.00	8000.00	20.00

1	1	44.99	11.83	1.83	50.00	8000.00	3.00
1	1	42.43	11.83	1.83	50.00	8000.00	3.00
1	1	47.00	11.83	1.83	50.00	8000.00	20.00
1	1	32.19	12.86	1.83	50.00	8000.00	3.00
1	1	35.48	12.86	1.83	50.00	8000.00	20.00
1	1	20.48	12.86	1.83	50.00	8000.00	3.00
1	1	24.69	12.86	1.83	50.00	8000.00	20.00
1	1	9.14	12.86	1.83	50.00	8000.00	3.00
1	1	12.98	12.86	1.83	50.00	8000.00	20.00
1	1	6.40	12.35	1.83	25.00	2500.00	3.00
1	0	6.13	12.35	1.83	25.00	2500.00	7.00
1	0	5.49	12.35	1.83	25.00	2500.00	4.00
1	1	5.49	12.35	1.83	25.00	2500.00	5.00
1	1	5.94	12.35	1.83	25.00	2500.00	6.00
1	1	9.69	12.35	1.83	25.00	2500.00	20.00
1	1	12.44	12.35	1.83	25.00	2500.00	3.00
1	0	11.70	12.35	1.83	25.00	2500.00	7.00
1	1	11.43	12.35	1.83	25.00	2500.00	4.00
1	0	11.98	12.35	1.83	25.00	2500.00	6.00
1	1	16.09	12.35	1.83	25.00	2500.00	20.00
1	1	18.84	12.35	1.83	25.00	2500.00	3.00
1	0	18.20	12.35	1.83	25.00	2500.00	7.00
1	1	17.83	12.35	1.83	25.00	2500.00	4.00
1	0	18.56	12.35	1.83	25.00	2500.00	6.00
1	1	12.53	12.35	1.83	25.00	2500.00	20.00
1	1	24.05	12.35	1.83	25.00	4000.00	3.00
1	0	23.68	12.35	1.83	25.00	4000.00	7.00
1	1	23.41	12.35	1.83	25.00	4000.00	4.00
1	0	23.87	12.35	1.83	25.00	4000.00	6.00
1	1	19.29	12.35	1.83	25.00	4000.00	3.00
1	0	18.29	12.35	1.83	25.00	4000.00	7.00
1	0	17.83	12.35	1.83	25.00	4000.00	4.00
1	1	18.93	12.35	1.83	25.00	4000.00	6.00
1	1	21.95	12.35	1.83	25.00	4000.00	20.00
1	1	13.72	12.35	1.83	25.00	4000.00	3.00
1	0	12.80	12.35	1.83	25.00	4000.00	7.00
1	0	12.34	12.35	1.83	25.00	4000.00	4.00
1	0	13.26	12.35	1.83	25.00	4000.00	6.00
1	1	16.55	12.35	1.83	25.00	4000.00	20.00
1	1	7.59	12.86	1.83	25.00	4000.00	3.00
1	0	7.13	12.86	1.83	25.00	4000.00	7.00
1	1	6.86	12.86	1.83	25.00	4000.00	4.00
1	0	7.41	12.86	1.83	25.00	4000.00	6.00
1	1	10.42	12.86	1.83	25.00	4000.00	20.00

APS-135 4 MAY 85 UNALERTED,

5	5	12.80	9.26	1.37	25.00	2500.00	3.00
5	5	19.02	9.26	1.37	25.00	2500.00	3.00
5	5	20.39	10.80	1.37	25.00	2500.00	3.00
5	5	14.26	10.80	1.37	25.00	2500.00	3.00
5	5	8.23	10.80	1.37	25.00	2500.00	3.00
5	2	8.23	10.80	1.37	25.00	2500.00	4.00
5	5	2.38	10.80	1.37	25.00	2500.00	3.00
5	3	2.38	10.80	1.37	25.00	2500.00	4.00
5	5	4.94	10.80	1.37	25.00	4000.00	3.00
5	4	4.94	10.80	1.37	25.00	4000.00	4.00
5	1	4.94	10.80	1.37	25.00	4000.00	6.00
5	5	10.97	10.80	1.37	25.00	4000.00	3.00
5	4	10.97	10.80	1.37	25.00	4000.00	4.00
5	0	10.97	10.80	1.37	25.00	4000.00	6.00
5	5	17.37	10.80	1.37	25.00	4000.00	3.00
5	0	17.37	10.80	1.37	25.00	4000.00	4.00
5	5	6.40	12.35	1.83	25.00	2500.00	3.00
5	5	5.49	12.35	1.83	25.00	2500.00	5.00
5	2	5.94	12.35	1.83	25.00	2500.00	6.00
5	5	12.44	12.35	1.83	25.00	2500.00	3.00
5	3	11.43	12.35	1.83	25.00	2500.00	4.00
5	5	18.84	12.35	1.83	25.00	2500.00	3.00
5	4	17.83	12.35	1.83	25.00	2500.00	4.00
5	5	24.05	12.35	1.83	25.00	4000.00	3.00
5	5	23.41	12.35	1.83	25.00	4000.00	4.00
5	5	19.29	12.35	1.83	25.00	4000.00	3.00
5	1	18.93	12.35	1.83	25.00	4000.00	6.00
5	5	13.72	12.35	1.83	25.00	4000.00	3.00
5	5	7.59	12.86	1.83	25.00	4000.00	3.00
5	5	6.86	12.86	1.83	25.00	4000.00	4.00

APS-135 5 MAY 85 ALERTED

1	1	4.57	9.77	1.68	25.00	2500.00	3.00
1	0	4.30	9.77	1.68	25.00	2500.00	7.00
1	1	4.02	9.77	1.68	25.00	2500.00	4.00
1	0	2.93	9.77	1.68	25.00	2500.00	5.00
1	0	2.93	9.77	1.68	25.00	2500.00	6.00
1	1	7.32	9.77	1.68	25.00	2500.00	20.00
1	1	7.50	9.77	1.68	25.00	2500.00	21.00
1	1	9.69	9.77	1.68	25.00	2500.00	3.00
1	0	9.42	9.77	1.68	25.00	2500.00	7.00
1	0	9.14	9.77	1.68	25.00	2500.00	4.00
1	1	8.69	9.77	1.68	25.00	2500.00	5.00
1	0	8.69	9.77	1.68	25.00	2500.00	6.00
1	1	12.62	9.77	1.68	25.00	2500.00	20.00
1	0	12.34	9.77	1.68	25.00	2500.00	21.00
1	1	16.73	9.77	1.52	25.00	2500.00	3.00
1	0	16.46	9.77	1.52	25.00	2500.00	7.00
1	1	16.28	9.77	1.52	25.00	2500.00	4.00
1	0	15.27	9.77	1.52	25.00	2500.00	5.00
1	0	15.27	9.77	1.52	25.00	2500.00	6.00
1	1	19.20	9.77	1.52	25.00	2500.00	20.00
1	1	19.66	9.77	1.52	25.00	2500.00	21.00
1	1	19.11	7.20	1.52	25.00	4000.00	3.00
1	0	18.84	7.20	1.52	25.00	4000.00	7.00
1	1	18.65	7.20	1.52	25.00	4000.00	4.00
1	1	18.01	7.20	1.52	25.00	4000.00	5.00
1	0	18.01	7.20	1.52	25.00	4000.00	6.00
1	1	20.94	7.20	1.52	25.00	4000.00	20.00
1	1	21.21	7.20	1.52	25.00	4000.00	21.00
1	1	15.64	7.20	1.52	25.00	4000.00	3.00
1	0	15.27	7.20	1.52	25.00	4000.00	7.00
1	0	15.00	7.20	1.52	25.00	4000.00	4.00
1	0	13.90	7.20	1.52	25.00	4000.00	5.00
1	0	13.90	7.20	1.52	25.00	4000.00	6.00
1	1	17.74	7.20	1.52	25.00	4000.00	20.00
1	1	18.11	7.20	1.52	25.00	4000.00	21.00
1	1	9.69	7.20	1.52	25.00	4000.00	3.00
1	0	9.42	7.20	1.52	25.00	4000.00	7.00
1	0	9.14	7.20	1.52	25.00	4000.00	4.00
1	1	8.69	7.20	1.52	25.00	4000.00	5.00
1	0	8.69	7.20	1.52	25.00	4000.00	6.00
1	1	11.80	7.20	1.52	25.00	4000.00	20.00
1	1	11.16	7.20	1.52	25.00	4000.00	21.00
1	1	3.93	7.20	1.52	25.00	4000.00	3.00
1	0	3.75	7.20	1.52	25.00	4000.00	7.00
1	1	3.57	7.20	1.52	25.00	4000.00	4.00
1	0	2.38	7.20	1.52	25.00	4000.00	5.00
1	0	2.38	7.20	1.52	25.00	4000.00	6.00
1	1	5.58	7.20	1.52	25.00	4000.00	20.00
1	1	5.94	7.20	1.52	25.00	4000.00	21.00
1	1	8.69	7.20	1.52	25.00	4000.00	3.00
1	0	8.23	7.20	1.52	25.00	4000.00	7.00
1	0	8.05	7.20	1.52	25.00	4000.00	4.00

1	0	7.32	7.20	1.52	25.00	4000.00	5.00
1	0	7.32	7.20	1.52	25.00	4000.00	6.00
1	1	10.06	7.20	1.52	25.00	4000.00	20.00
1	1	10.61	7.20	1.52	25.00	4000.00	21.00
1	1	14.63	7.20	1.52	25.00	4000.00	3.00
1	0	14.45	7.20	1.52	25.00	4000.00	7.00
1	1	14.26	7.20	1.52	25.00	4000.00	4.00
1	0	12.80	7.20	1.52	25.00	4000.00	5.00
1	0	12.80	7.20	1.52	25.00	4000.00	6.00
1	1	16.18	7.20	1.52	25.00	4000.00	20.00
1	1	16.55	7.20	1.52	25.00	4000.00	21.00
1	1	2.19	7.72	1.52	50.00	8000.00	3.00
1	1	3.84	7.72	1.52	50.00	8000.00	20.00
1	0	4.30	7.72	1.52	50.00	8000.00	21.00
1	1	13.17	8.74	1.22	50.00	8000.00	3.00
1	0	14.45	8.74	1.22	50.00	8000.00	20.00
1	0	14.90	8.74	1.22	50.00	8000.00	21.00
1	1	23.96	8.74	1.22	50.00	8000.00	3.00
1	1	28.53	8.74	1.22	50.00	8000.00	20.00
1	0	28.99	8.74	1.22	50.00	8000.00	21.00
1	1	38.04	8.74	1.22	50.00	8000.00	3.00
1	1	37.49	8.74	1.22	50.00	8000.00	4.00
1	1	40.23	8.74	1.22	50.00	8000.00	20.00
1	1	40.78	8.74	1.22	50.00	8000.00	21.00
1	1	40.23	8.74	1.22	50.00	8000.00	3.00
1	1	42.06	8.74	1.22	50.00	8000.00	20.00
1	1	42.98	8.74	1.22	50.00	8000.00	21.00
1	1	28.53	7.72	1.22	50.00	8000.00	3.00
1	1	27.43	7.72	1.22	50.00	8000.00	5.00
1	1	31.27	7.72	1.22	50.00	8000.00	20.00
1	1	32.00	7.72	1.22	50.00	8000.00	21.00
1	1	16.46	7.72	1.22	50.00	8000.00	3.00
1	1	18.84	7.72	1.22	50.00	8000.00	20.00
1	0	19.57	7.72	1.22	50.00	8000.00	21.00
1	1	3.66	7.72	1.52	50.00	8000.00	3.00
1	1	5.49	7.72	1.52	50.00	8000.00	20.00
1	1	6.04	7.72	1.52	50.00	8000.00	21.00
1	1	0.64	5.66	1.52	25.00	2500.00	3.00
1	0	0.73	5.66	1.52	25.00	2500.00	7.00
1	1	0.91	5.66	1.52	25.00	2500.00	4.00
1	1	3.29	5.66	1.52	25.00	2500.00	20.00
1	1	3.84	5.66	1.52	25.00	2500.00	21.00
1	1	5.58	5.66	1.52	25.00	2500.00	3.00
1	0	5.76	5.66	1.52	25.00	2500.00	7.00
1	1	6.04	5.66	1.52	25.00	2500.00	4.00
1	0	4.75	5.66	1.52	25.00	2500.00	5.00
1	0	4.75	5.66	1.52	25.00	2500.00	6.00
1	1	10.15	5.66	1.52	25.00	2500.00	20.00
1	1	10.79	5.66	1.52	25.00	2500.00	21.00
1	1	0.82	5.66	1.52	25.00	2500.00	3.00
1	0	0.82	5.66	1.52	25.00	2500.00	7.00
1	0	0.82	5.66	1.52	25.00	2500.00	4.00

1	1	5.30	5.66	1.52	25.00	2500.00	20.00
1	1	5.94	5.66	1.52	25.00	2500.00	21.00
1	1	19.39	5.66	1.52	25.00	2500.00	3.00
1	0	19.66	5.66	1.52	25.00	2500.00	7.00
1	1	20.03	5.66	1.52	25.00	2500.00	4.00
1	1	18.75	5.66	1.52	25.00	2500.00	5.00
1	0	18.75	5.66	1.52	25.00	2500.00	6.00
1	1	13.72	5.66	1.52	25.00	2500.00	3.00
1	0	13.90	5.66	1.52	25.00	2500.00	7.00
1	1	14.17	5.66	1.52	25.00	2500.00	4.00
1	0	12.44	5.66	1.52	25.00	2500.00	5.00
1	0	12.44	5.66	1.52	25.00	2500.00	6.00
1	1	9.88	5.66	1.52	25.00	2500.00	20.00
1	1	10.52	5.66	1.52	25.00	2500.00	21.00
1	1	6.68	5.66	1.83	25.00	2500.00	3.00
1	0	6.86	5.66	1.83	25.00	2500.00	7.00
1	1	7.13	5.66	1.83	25.00	2500.00	4.00
1	0	5.67	5.66	1.83	25.00	2500.00	5.00
1	0	5.67	5.66	1.83	25.00	2500.00	6.00
1	1	12.44	5.66	1.83	25.00	2500.00	20.00
1	1	12.98	5.66	1.83	25.00	2500.00	21.00
1	1	6.58	5.66	1.83	25.00	4000.00	3.00
1	0	6.77	5.66	1.83	25.00	4000.00	7.00
1	1	6.95	5.66	1.83	25.00	4000.00	4.00
1	0	4.94	5.66	1.83	25.00	4000.00	5.00
1	0	4.94	5.66	1.83	25.00	4000.00	6.00
1	1	12.44	5.66	1.83	25.00	4000.00	20.00
1	1	13.17	5.66	1.83	25.00	4000.00	21.00
1	1	12.44	5.66	1.83	25.00	4000.00	3.00
1	0	12.71	5.66	1.83	25.00	4000.00	7.00
1	1	12.98	5.66	1.83	25.00	4000.00	4.00
1	1	11.89	5.66	1.83	25.00	4000.00	5.00
1	1	11.89	5.66	1.83	25.00	4000.00	6.00
1	1	18.47	5.66	1.83	25.00	4000.00	20.00
1	1	19.20	5.66	1.83	25.00	4000.00	21.00
1	1	18.56	5.66	1.83	25.00	4000.00	3.00
1	0	18.65	5.66	1.83	25.00	4000.00	7.00
1	0	18.75	5.66	1.83	25.00	4000.00	4.00
1	1	18.38	5.66	1.83	25.00	4000.00	5.00
1	0	18.38	5.66	1.83	25.00	4000.00	6.00

APS-135 5 MAY 85 UNALERTED

5	5	4.57	9.77	1.68	25.00	2500.00	3.00
5	4	4.02	9.77	1.68	25.00	2500.00	4.00
5	5	9.69	9.77	1.68	25.00	2500.00	3.00
5	0	8.69	9.77	1.68	25.00	2500.00	5.00
5	5	16.73	9.77	1.52	25.00	2500.00	3.00
5	5	16.28	9.77	1.52	25.00	2500.00	4.00
5	5	19.11	7.20	1.52	25.00	4000.00	3.00
5	0	18.65	7.20	1.52	25.00	4000.00	4.00
5	5	18.01	7.20	1.52	25.00	4000.00	5.00
5	5	15.64	7.20	1.52	25.00	4000.00	3.00
5	5	9.69	7.20	1.52	25.00	4000.00	3.00
5	2	8.69	7.20	1.52	25.00	4000.00	5.00
5	5	3.93	7.20	1.52	25.00	4000.00	3.00
5	0	3.57	7.20	1.52	25.00	4000.00	4.00
5	5	8.69	7.20	1.52	25.00	4000.00	3.00
5	5	14.63	7.20	1.52	25.00	4000.00	3.00
5	5	14.26	7.20	1.52	25.00	4000.00	4.00
5	5	0.64	5.66	1.52	25.00	2500.00	3.00
5	0	0.91	5.66	1.52	25.00	2500.00	4.00
5	5	5.58	5.66	1.52	25.00	2500.00	3.00
5	5	6.04	5.66	1.52	25.00	2500.00	4.00
5	5	0.82	5.66	1.52	25.00	2500.00	3.00
5	4	19.39	5.66	1.52	25.00	2500.00	3.00
5	5	20.03	5.66	1.52	25.00	2500.00	4.00
5	4	18.75	5.66	1.52	25.00	2500.00	5.00
5	5	13.72	5.66	1.52	25.00	2500.00	3.00
5	4	14.17	5.66	1.52	25.00	2500.00	4.00
5	5	6.68	5.66	1.83	25.00	2500.00	3.00
5	5	7.13	5.66	1.83	25.00	2500.00	4.00
5	5	6.58	5.66	1.83	25.00	4000.00	3.00
5	5	6.95	5.66	1.83	25.00	4000.00	4.00
5	5	12.44	5.66	1.83	25.00	4000.00	3.00
5	5	12.98	5.66	1.83	25.00	4000.00	4.00
5	5	11.89	5.66	1.83	25.00	4000.00	5.00
5	5	11.89	5.66	1.83	25.00	4000.00	6.00
5	5	18.56	5.66	1.83	25.00	4000.00	3.00
5	5	18.38	5.66	1.83	25.00	4000.00	5.00